Nature

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ILLUSTRATED JOURNAL OF SCIENCE

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MARCH 6, 1913.

SCIENTIFIC WORTHIES.

XL.—SIR J. J. THOMSON, O.M., F.R.S.

It is impossible to think of the rapid and profound evolution which occurred in the fundamental conceptions of natural philosophy during the final years of the past century without one figure looming large in the mental picture—that of the celebrated physicist of the University of Cambridge. In effect, the new and fruitful trend assumed by the science of physics in recent years has been in great part due to the happy intuition of Sir J. J. Thomson and to the experimental researches unwearyingly pursued by him and his students in the celebrated Cavendish Laboratory.

One circumstance is particularly striking in that movement—the unforeseen opening out of new and vast horizons to the physicist precisely at the moment when the electromagnetic theory of light had been victoriously acclaimed—a theory which not only gathered into one marvellously harmonious synthesis all the phenomena of the physical world, but at the same time satisfied that natural scientific instinct, which seeks for the greatest simplicity in its explanation of natural phenomena, by attributing to a single medium, the æther, the double office of transmitting electrical and magnetic forces as well as the waves of light.

In spite of this, physicists were not able long to rest upon their laurels; for certain classes of phenomena, which, perhaps, it was hoped would find an easy explanation, proved quite resistant to elucidation unless accessory hypotheses were devised.

If we go back in thought fifteen or twenty years, it is plainly visible that, after the definitive triumph of Maxwell's theory in the experimental field with the work of Hertz and his successors, the great unknown which we call electricity was still considered by all, in its real nature, more or less as an incompressible fluid which could displace itself in dielectrics, overcoming a certain elasticity, or flow in a conductor; whilst the principal electrostatic facts, metallic conduction and some other phenomena could be considered as intimately known. But the propagation of electricity in electrolytes, and more especially in gases, remained in part problematical.

To these two classes of phenomena was not attributed the importance they should have merited. But even then was perceived one most important specific character of electricity in the case of its propagation in electrolytes, namely, its apportionment into small parts, identical among themselves, and representing the charges corresponding with each valence of the electrolytic ions. The significance of this fact could not escape the mind of Maxwell; and it led him to consider those charges as *atoms* of electricity. Nor could it escape Helmholtz, who acutely pointed out that the existence of such charges must be considered possible, even apart from the ponderable matter with which they are ordinarily accompanied, even if it were only during the short time in which, having left the ion, they are about to enter the electrode to feed the current in the metallic portion of the circuit.

The existence of atoms of electricity, or of "electrons," according to the felicitous expression proposed by Stoney, was accepted without hesitation as a fundamental hypothesis in the theories constructed by Larmor, Lorentz and other mathematical physicists; and the former of these so

far back as 1894 succeeded in outlining an electrical theory of matter. But, however seductive these theoretical investigations appeared, and in their comprehensiveness they represented a considerable advance on earlier theories, the real existence of electrons could not be accepted by physicists until a satisfactory experimental demonstration of their existence was forthcoming.

To succeed in such a demonstration undoubtedly appeared to everyone a sufficiently difficult matter; yet such has actually been achieved, thanks to the study of the kathode rays, that is, of certain peculiarities presented by electrical discharge and already known for some considerable time.

The phenomena of discharge have always attracted the attention of physicists, and innumerable studies have been made in this field. The peculiarities which they present, varied as they are almost indefinitely, and certain brilliant aspects which they possess, even though not always of the highest scientific interest, have rendered these studies so attractive, that it is difficult for anyone who has once pursued them to free himself from their seductiveness and pursue other researches. A rich material of facts thus went on accumulating, between which, however, in the majority of cases there was no intimate connecting link; this material was later to be coordinated by the electronic theory, which in turn gained many indirect confirmations from it. Finally, when, with the perfecting of technique, it became an easy matter to produce the greatest rarefaction of gases, the phenomena of the kathode rays assumed their due importance in the eyes of physicists; and all those who, by natural disposition or as a result of long experience in physical researches, possessed that fine intuition which in certain cases appears almost as a true divination, presaged that from the study of the kathode rays would accrue results of capital importance, capable of throwing light on the nature of electricity.

The very brilliant and ingenious experiments described by Crookes, and the theory of "radiant matter" proposed by him to explain them, gave a great impulse in the direction which has led to the actual views of to-day. It is true that that theory was combated, unfortunately, even by physicists of such high reputation as Hertz; but there were some, at least, who at once welcomed it with enthusiasm.

The present writer can boast that he was one of this small band, and that he drew from the theory the inspiration of numerous experiments, demonstrating the existence of electrified particles (ions) in gases under atmospheric pressure transmitting the discharge, and capable of producing with their movements regulated by electrical forces phenomena of "electrical shadows" similar to those produced by the kathode rays.

Meanwhile, shortly afterwards and independently of the explanation given of the kathode rays, various physicists sought to explain by the presence of mobile charges the conducting properties possessed by gases in certain circumstances, and it then appeared that they could not do better than apply to gases the mechanism imagined in the case of electrolytes. Schuster, Arrhenius, Elster, Geitel and others obtained noteworthy results in this field, bringing forward numerous proofs of the existence of ions in gases, and basing on the facts observed the explanation of divers phenomena.

It was not easy, however, to apply directly to gases the electrolytic theory. In the first place, an enormous difference exists between the two orders of phenomena as regards the difference of potential required to bring about a transmission of electricity, this difference being exceedingly small in the case of liquids and relatively great in the case of gases. Another formidable difficulty also presented itself in the fact that, whilst it is a most natural thing for atoms of different chemical nature to carry charges of different sign, so that, for example, there are negative ions of oxygen and positive ions of hydrogen, it was not easy to conceive that, in a given simple gas, there could exist ions of the same chemical nature but some charged positively and some negatively.

But this difficulty disappeared when, by the classical experiments of J. J. Thomson, it was rendered probable, and demonstrated, so far as this is humanly possible, that negative electrons or "corpuscles" exist and form an integral part of the structure of the atoms.

The suggestive fact having been observed by Perrin, and then by Thomson, of the effective transport of negative charges by the kathode rays, a fact which suggested the hypothesis that such rays consisted of the movement of particles expelled from the kathode, Thomson commenced in 1897 those famous experimental researches in which he succeeded in measuring, at the same time, the ratio e/m between charge and mass of the said particles and their velocity v. Having obtained for v a value clearly inferior to the velocity of light, and, above all, a value for e/m nearly two thousand times that corresponding

with the ion of hydrogen, and, moreover, as it could be shown that the same identical particles always resulted on changing the substances dealt with in the experiments (electrodes, gases, &c.), it was revealed that those particles were neither atoms nor molecules, but the electrons themselves, contained in and expelled from the atoms. Others had previously employed the action of a magnetic field on the kathode rays to obtain the foregoing determinations, and Thomson himself had made a similar attempt, but without attaining immediately the results indicated.

It is here clearly seen how a theoretical concept or a happy hypothesis devised to guide the experimenter can be of the greatest assistance in obtaining far-reaching results. In fact, it is difficult to decide which most to admire in Thomson—the ability of the proved experimenter or the felicitous intuition of the keen thinker which leads him to foresee and anticipate the final interpretation of the facts observed. Even to-day it would require most prolonged and difficult experimental work to show in a rigorous manner that the ratio e/m is really (save the influence of v on the value of m) constant on all occasions, whatever be the circumstances in which the kathode rays originate (the nature of the electrodes, of the rarefied gas, the pressure of the latter, &c.). But with inspired generalisation, Thomson, conscious of the accuracy of his own measurements, and with great faith in the conceptions that were becoming matured in his mind, did not hesitate to proclaim that his experiments furnished the proof of the existence of particles negatively electrified and having a mass not greater than one two-thousandth part of the mass of the atom of hydrogen.

With this was assumed that the charge of each was equal to that corresponding with one atomic valence; but in strictness the results obtained could have been interpreted alternatively by attributing to the said particles somewhat larger charges and a mass of atomic magnitude. However probable the first interpretation seemed, there still remained a gap to fill in. Thomson succeeded in this by utilising the studies carried out in his laboratory by C. T. R. Wilson, who had recognised that electrified particles, and more particularly the negative ones, acted as nuclei of condensation for water vapour. The experimental method adopted by Thomson, which enabled him to evaluate the charge of each single corpuscle, is a true model of ingenuity. The numerical result obtained was perfectly favourable to the interpretation adopted in the earlier experiments; and if not at first very exact, was soon corrected by the later experiments of H. A. Wilson and of Thomson himself.

When the results were first communicated to the British Association in 1899, they were so favourably received that it may be said that from that date the new ideas on the nature of the kathode rays were accepted by the majority of physicists.

Meanwhile other discoveries of considerable importance were made, which brought unexpected confirmation to these hypotheses. The phenomenon discovered by Zeeman, which was at once explained by the electronic theory of Lorentz, and the discovery of radio-activity by Becquerel, came at the most opportune moment in support of the electrical theory of matter, which now became almost irresistible and had its basis in the experiments of Thomson which have been recorded.

It was not, in fact, possible to conceive how the kathode rays could be composed of corpuscles always identical whatever the nature of the bodies present, or taking part in their formation, without supposing that such corpuscles pre-existed in the atoms of every substance, and were thus identical with the electrons already assumed to be constituent parts of the atoms. From this to the hypothesis that the atoms consist only of electrons is a short step. And, in truth, the mass of the corpuscles may be entirely electromagnetic, that is, due solely to the motion with which the electrical charges are possessed. The well-known experiments of Kaufmann also came at an opportune moment in support of this opinion, demonstrating as they did that the mass of the electrons emitted by radio-active bodies appears so much the greater the greater their velocity. Thus, from experiments on the kathode rays a theory was evolved the philosophical import of which is evidently of the highest, inasmuch as it enables one to eliminate one of the fundamental or primitive entities (matter) which have been invoked to give an explanation of the phenomena of the physical world.

One can conceive, in fact, the possibility of building up a system of philosophy with only æther and electrons as a basis; a system all the more seductive on account of the simplification that it carries with it.

The known dualism of electricity of two signs, which causes differences more or less considerable in every fact, becomes accentuated when the single electrons are considered. In fact, in spite of the numerous and varied attempts that have been made to demonstrate the existence of positive electrons,

that is, of positive charges endowed with a mass (electromagnetic) of the same order of magnitude as that of the negative electrons, all such efforts have ended in failure. It is, therefore, natural to consider only the negative electrons, from which one may eliminate the adjective, and admit that in the positive ions each valence is due, not to the addition of a positive electron, but to the subtraction of a negative electron or electron strictly so called. This naturally led Thomson to attribute to positive electricity certain special characters within the atoms, and to assume for these a special structure in which the negative electrons have a preponderating influence; which view is in conformity with known facts, and, in particular, with the Zeeman effect, from which is deduced, as is well known, that the emission of light has its origin in the vibration of negative electrons.

Taking, as point of departure, an idea suggested by Lord Kelvin's "Aepinus Atomised" (according to the picturesque expression employed by him), Thomson assumed that a neutral atom is composed of a sphere of positive electricity in which are immersed negative electrons, the total charge of which is equal in absolute value to that of the sphere. The electrical force which acts on each of these throughout the positive sphere is proportional to the distance from the centre, and maintains them in closed orbits, the stability of which needs a special distribution of the electrons themselves.

Some concrete idea of such a species of solar systems was opportunely found in the old experiment of floating magnets, due to the physicist Mayer, which was thus rescued from the unmerited oblivion in which it had been left.

This hypothesis of the structure of the atoms, although most daring, seems to respond to all exigencies. It may be modified with the progress of time, and certainly needs completion; but it is probable that its essential features will be retained by the science of the future.

A necessary complement of the present-day theory of the kathode rays is found in the theory elaborated in much detail by J. J. Thomson to explain the production and nature of the rays discovered by Röntgen. It presents such a character of evidence, and, in short, is so intuitive, that everyone feels that he could have conceived it himself, which idea, however, is only one of many similar illusions of *amour propre*. Indeed, how can one avoid admitting the production of sudden electromagnetic perturbations in the æther, at the spot where the electrons are entirely arrested or retarded, as occurs when the kathode rays encounter an obstacle? It will naturally follow, I believe, that the X-rays will be considered as the manifestation of those perturbations, in spite of there having been proposed recently a new hypothesis, according to which these rays are of a corpuscular nature and composed of the motion of neutral couples (one negative electron and one positive). It will be necessary at least to bring proof on proof for this new hypothesis before Thomson's theory is abandoned. And in such a case it will be necessary to establish what happens to the perturbations due to the variations of velocity of the electrons constituting the kathode rays, which undoubtedly are produced.

In creating the actual current of ideas relative to the nature of matter and the common prime cause of phenomena of light and electromagnetism, in addition to the experimental work of Thomson other discoveries of recent years have contributed, above all, that of Zeeman (1897), to which I have already alluded, and that of radio-activity—the latter thanks to the very simple and ingenious explanation given by Rutherford and Soddy. If from the measurements carried out on the kathode rays was demonstrated the existence of the electrons as integral parts of the atoms, the facts of radio-activity lead us further—to the view that the atom is a complex structure of negative electrons and positive ions, or at least that at a given moment, perhaps in consequence of the continuous irradiation of part of its energy, there can separate electrons and positive ions, the latter being, at any rate in the cases studied as yet, not other than bivalent ions of helium. This interpretation of radio-active phenomena seems so natural as to give rise easily to the illusion that the phenomena themselves could have been foreseen. On the other hand, they may make the importance of Thomson's work appear to some less than it undoubtedly is; but it is necessary to go back in mind to the period at which it was carried out and take account of the mode of thought prevailing at the time, to appreciate the acuteness and originality of mind which were necessary in order to dare to snatch from the atom its dogmatic prerogatives of indivisibility and invariability.

There are other examples in the history of physical science of discoveries made at short intervals of time converging to a truth which the discovery of a final fact put into a clear light. It is usual then to say that that truth was "in the air," as if any person in favourable circumstances would have been able to discover it. I do not believe, in any case, that the same can be

said of the discoveries of which we are speaking; moreover, such an opinion, too frequently repeated, should be rejected. If one looks closely, it is possible to recognise that, in the majority of cases, not blind fortune is the aid of the happy discoverer, but the special attitude of mind and the scientific preparation he possesses. In the concrete case it is evident that Thomson, from the commencement of his researches, was unconsciously preparing himself for the grand discovery of the true nature of the kathode rays. It is sufficient in proof of this to cite his noteworthy memoir of 1881, relative to the electrical and magnetic effects produced by the motion of electrified bodies, for which Crookes's theory of radiant matter had furnished the inspiration.

The work published by Sir J. J. Thomson during recent years constitutes the complement and crown of his principal achievement. Thus, in a short time he was able to collect into a body of doctrine everything which relates to the propagation of electricity in gases, and of which his well-known treatise on the subject is the embodiment of the faith—a work that is consulted by all who conduct experimental researches in this field, which is very far from having yielded all its fruits. In this volume are treated with much detail the production of ions in gases, their disappearance, their velocities under certain contingencies, &c. Frequently the original experiments of the author and his students have rendered possible the completion of the explanation of a particular phenomenon, or put in evidence some new detail or the laws which it obeys. Moreover, making use of the facts thus accumulated and the relationship existing between them, Thomson had at his disposal the elements necessary to found a theory of electrical discharge more comprehensive than any previously proposed, which, although not yet complete and definitive, has enabled him to point out the relations between facts apparently disparate which previously could only be described separately and disconnectedly.

Quite recently the activity of the Cambridge physicist seems to have been concentrated on the study of the properties of the positive rays, and especially of the so-called canal rays. This is a field of studies in which several most daring workers (Wien, Stark, &c.) have amassed a rich harvest of most important results; none the less, J. J. Thomson, by the adoption of ingenious experimental arrangements, in part new, and especially by virtue of happily inspired and most original interpretations, has drawn, and continues to draw, from his researches consequences the import of which far surpasses the limits in which they might have been expected to be confined.

Of these researches physicists await with some impatience the publication of a treatise which shall present them not merely in order of date, but with that arrangement, clearness and concision which are precious characteristics of Thomson's writings.

However insufficient and incomplete, the foregoing considerations will help to make clear the signal value of Thomson's work. Such, at least, has been my intention. Although compelled to abandon an analysis of the extensive scientific productions of the great physicist, I trust that all will be, like myself, convinced that his work belongs to the category of those investigations which leave an indelible impress on the progress of science.

AUGUSTO RIGHI.

AN ENGLISH TEXT-BOOK OF PROTOZOOLOGY.

An Introduction to the Study of the Protozoa: with Special Reference to the Parasitic Forms. By Prof. E. A. Minchin, F.R.S. Pp. xi+520. (London: Edward Arnold, 1912.) Price 21s. net.

THIS work on the Protozoa by Prof. Minchin may be considered as an attempt to confine a knowledge of the philosophical and the practical side of the modern science of protozoology within the limits of one volume.

After discussing the one-celled organisms grouped for convenience under the term Protista, their modes of life are considered. Various types of nutrition—purely animal, plant-like, feeders on decaying matter, and finally parasitic methods—are described and illustrated. The "mutual aid" associations of the animal world known as symbiotic unions are charmingly portrayed, and in contrast the interrelations of hosts and parasites are set forth. A most interesting study in animal mechanics is presented, together with a broad account of the organisation of the Protozoa. To the cytologist there is much of interest in the chapter dealing with the nucleus and nuclear structure. The author draws a distinction "between organisms of the 'cellular' grade, with distinct nucleus and cytoplasm, and those of the 'bacterial' grade, in which the chromatin does not form a distinct nucleus." He considers that a "bacterial type of organism" is "not to be regarded as a cell, but as representing a condition antecedent to the evolution of the true cellular type of structure." Such a distinction seems somewhat arbitrary and unnatural, and tends to overlook the importance of intermediate forms.

The problems of the propagation and perpetuation of races of organisms and the modes of transference of the parasitic forms are both of great interest and of economic importance. The parasites have multiplicative methods of reproduction which are necessary for the increase of their numbers within one host, while propagative forms are produced for their transference to other hosts. The function of syngamy (fusion of gametes) as a factor in keeping the tendency to variation within the specific limits is a view worthy of more attention. The many forms assumed by one organism (polymorphism) are traced as arising from adaptation to environment, to growth and development, and to sexual differentiation. The general part of the book closes with an interesting chapter dealing with the vital physiological phenomena shown by Protozoa.

Following the general consideration of the Protozoa, eight chapters are devoted to an account of their systematic grouping, and the enormous extent of the group can be realised by scanning the sequence of genera or by referring to the copious index. Prof. Minchin considers that two types of organisation prevail among the Protozoa. The simpler or Sarcodine type possesses no permanent locomotor organs when mature, although such may be present in its youth form. The second or Mastigophoran type, comprising organisms often of small size, has permanent locomotor organs, flagella, which are lost in the resting phases. Subdivisions of each group are numerous. The very diverse organisms among the Rhizopoda, such as the Amœbæ, the sun-animalcules (Helizoa), the chalk and ooze-formers known as Foraminifera and Radiolaria, and the Mycetozoa (claimed also by the botanist as the slime fungi or Myxomycetes), are all considered. Perhaps some newer illustrations would be an improvement here.

The bionomics of the flagellates are of much interest, whether the parasitic forms or the tiny inhabitants of ponds (also claimed by the botanist as Algæ) are under discussion. The interest of the medical man will be claimed by the accounts of the sleeping-sickness parasites, and the causes of such diseases as kala-azar, oriental sore, and malaria. The agriculturist should be interested in the parasites of red-water and East Coast fever, so fatal to cattle, as well as in the accounts of Coccidia, fish tumours, and silkworm disease. Incidentally, it may be mentioned that Prof. Minchin does not now accept the results of Schaudinn's researches on the parasites of the little owl.

Certain organisms, considered by some as doubtfully Protozoa, such as the Spirochætes, causing African tick fever and relapsing fever, and the bodies responsible for small-pox, are briefly considered in the concluding chapter. Those who care for possible genealogies and speculations will also find here an account of the possible evolution and ancestry of the Protozoa.

In conclusion, it is a pity that certain blemishes in the form of loose statements, some inconsistencies of nomenclature (for example, the use of Coccidium, Piroplasma), and slightly partisan views on some contentious subjects have been allowed to creep in and mar the book, but doubtless these will disappear in the second edition. We would also suggest that an increase in the number of illustrations would be a very great advantage, and this should not be incommensurate with the cost of the book (21s. net). Some rather old figures could be replaced by others embodying the results of more recent and accepted research. Criticisms of technique employed some years ago are obviously futile, inasmuch as the said technique was the best available at the time. Also we are distinctly of opinion that the systematic part of the book should be enlarged. But it must be recognised that the task before Prof. Minchin was an enormous one, and he is to be congratulated on the successful issue of the work.

CHEMISTRY AND ITS APPLICATIONS.

A Dictionary of Applied Chemistry. Revised and enlarged edition. By Sir Edward Thorpe, C.B., F.R.S., assisted by eminent contributors. Vol. ii. Pp. viii+786. Vol. iii. Pp. viii+789. (London: Longmans, Green and Co., 1912.) Price 45s. net per volume.

As a notice of the first volume of the new edition of Thorpe's Dictionary appeared in the columns of NATURE for April 18, 1912, it is not necessary on the present occasion to do more than express cordial concurrence in the reviewer's high estimate of the character of the work and of the services rendered to the chemical world by the editor and his staff of contributors. In the two volumes before us the reader rather naturally turns first to those articles which specially illustrate the applications of science to industry, namely, those of which the subjects had not even come into practical existence at the date of the former edition. Metallography, for example, is one of these subjects, and is treated in a thoroughly masterly manner by Dr. Walter Rosenhain, of the National Physical Laboratory. Here is a subject which, originating fifty years ago in the microscopic study of rocks by Sorby, has been largely dependent for the advances

already made on the provision of instruments for measuring and recording temperatures above the range of the mercurial thermometer. Without the electrical pyrometer comparatively little would have been accomplished.

Another subject of the greatest chemical and commercial importance is the utilisation of atmospheric nitrogen, which has been treated in a complete and interesting article by Prof. Crossley. Up to the present the fixation of nitrogen in the form of nitrate has perhaps attracted most attention, and has been practised on the largest scale, but the recent announcement that the Badische Anilin- u. Soda-Fabrik has actually started the manufacture of ammonia from the combination of gaseous nitrogen and hydrogen by Haber's process is a further step of great significance.

Among other new subjects unrepresented in the former edition are "Colloids," by Dr. J. C. Philip, and "Corrosion and Fouling of Steel and Iron Ships," by Prof. Vivian B. Lewes; while several others, such as "Explosives," by Mr. G. H. Perry, and "Matches," by Mr. E. G. Clayton, have been largely added to and brought up to date. There is also a judicious unsigned historical article on the liquefaction of gases.

There are few deficiencies apparent on first acquaintance with the dictionary, and in the presence of so much that is admirable, hypercriticism may be deprecated. The inequality in length of the various articles is probably one of the most difficult questions which come before the editor in relation to such a work as this. The most glaring case noticeable in the two volumes before us is the assignment of 100 pages to naphthalene, while fuel receives only twenty-four pages and flame eight pages. In neither of these articles is there any reference to the important question of smoke production and prevention, which is surely a question of chemical as well as practical interest.

The attention of the editor may also be directed to the fact, though too late for remedy, that the article on essential oils, though containing much useful information, is distinguished from every other important article in the book by the absence of references or bibliography. It would probably provide a slight shock for Prof. Wallach to find that an article on this subject could be written without mention of his name. The writer of the article similarly ignores Schimmel's half-yearly reports, which furnish a large body of valuable information extending over many years, and cannot yet be considered to be replaced in this country by *The Perfumery and Essential Oil Record.*

All British chemists will certainly make frequent use of the new edition of the dictionary, and in doing so the majority will be glad of the adoption of a system of abbreviations of the titles of journals and books which is practically identical with the system with which all are familiar in the publications of the Chemical Society, and is much to be preferred to the contractions, often rather tiresome, used in the previous edition.

W. A. T.

PRACTICAL MATHEMATICS.

(1) *Practical Geometry and Graphics.* By E. L. Bates and F. Charlesworth. Pp. ix+621. (London: B. T. Batsford, 1912.) Price 4*s.* net.

(2) *Practical Mathematics.* By E. L. Bates and F. Charlesworth. Pp. ix+513. (London: B. T. Batsford, 1912.) Price 3*s.* net.

(3) *Analytical Geometry. A First Course.* By C. O. Tuckey and W. A. Nayler. Pp. xiv+367. (Cambridge: University Press, 1912.) Price 5*s.* net.

(4) *A Preparatory Arithmetic.* By C. Pendlebury. Pp. xiv+185+xxx. (London: George Bell and Sons, Ltd., 1912.) Price 1*s.* 6*d.*

(5) *Les Anaglyphes Géométriques.* By H. Vuibert. Pp. 32. (Paris: Librairie Vuibert, n.d.)

(1) THE contents of this volume fall into three sections: (*a*) plane geometry; (*b*) graphics; (*c*) descriptive geometry. The first deals with the calculation of areas and volumes, the fundamental geometrical constructions and the chief properties of the circle and conic. In the second the student is shown how to apply graphical methods to the solution of practical problems in mechanics, considerable space is devoted to the consideration of harmonic motion and systems of frameworks, and allusion is made to the use of vector products. The last section, which occupies nearly 200 pages, contains as full an account of the methods of practical solid geometry as any ordinary technical student is likely to require. The diagrams are clear and the quality of the examples is distinctly good.

(2) The authors have attempted to collect in as concise a form as possible all those portions of mathematics which are likely to be of use to practical students. The volume is self-contained in the sense that no previous knowledge is assumed, and its contents are designed to supply material for a course lasting between two and three years. About two-thirds of the book is devoted to arithmetic, algebra and geometry; due prominence is given to graphical methods; the treatment of mensuration is excellent, and the selection of those geometrical properties and ideas with which it is considered students should be familiar has been made with great care. The concluding part of the

book develops the fundamental ideas of trigonometry, vector geometry, mechanics, and the calculus. Considerations of space have made this section somewhat brief, but it should prove useful to those who regard it as an introduction to more advanced text-books.

(3) The distinguishing feature of this work is the early introduction of the equations of curves of the second and higher degrees. It is an undoubted fact that if a student is compelled to make himself thoroughly familiar with the analytical geometry of the straight line and circle before proceeding to other loci, he finds it hard to appreciate the purpose and the value of the work in which he is engaged. The boy who intends to specialise in mathematics will not derive any harm from pursuing this course; in fact, there is much to be said for giving him a sound grounding in the elementary principles at the outset; but those who are taking scientific or engineering courses, and therefore require less manipulative skill, secure what they need from a course which is less detailed and more general in character. Their requirements are met admirably by such a treatment as is given in the work before us. This will be made clear by a brief enumeration of the subjects and the order in which they are taken: (1) standard equations of the straight line, circle, ellipse, parabola, hyperbola; (2) gradient of curves; (3) locus problems; (4) polar coordinates with applications to the limaçon, cardioid, cycloid, etc.; (5) the conic based on the focus-directrix definition; (6) the solid geometry of the plane, straight line, and simple curved surfaces.

There is an excellent collection of examples, answers to which are given at the end of the book. We would suggest that an index should be added in future editions.

(4) During the last ten years a number of valuable reports on the teaching of elementary mathematics have been issued by the Mathematical Association, and they have exercised a very considerable influence on the curriculum and the methods employed. As evidence of this it is necessary only to refer to the changes which examining bodies have made in their regulations and to the alteration in character of modern text-books. The present work is based on the report dealing with the teaching of arithmetic in preparatory schools. Concrete and abstract questions are taken side by side, those parts of the subject which are of small intrinsic importance are omitted, and the artificial divisions of the subject-matter into a number of standardised types of problems are avoided. We have no hesitation in recommending this book for use with junior students.

(5) This pamphlet describes a means of exhibiting three-dimensional figures, examples of which were shown at the International Congress at Cambridge last August. Two perspective figures are drawn close together on the paper in the complementary colours green and red, and they are viewed through red and green transparent screens. A highly striking effect is obtained. It is clear that the simplicity of the method will contribute largely to its practical utility. For purposes of demonstration, in the teaching of solid geometry, it should be invaluable. About thirty examples are given; the diagram which represents a cube with one diagonal vertical with its plan and elevation is particularly good. The figures of the cylinder seen from one end and the section of a tetrahedron by parallel planes appear to be a trifle out of drawing.

OUR BOOKSHELF.

Télégraphie sans Fil: Reception des Signaux horaires et des Télégrammes météorologiques. By Dr. Pierre Corret. Pp. 93. (Paris: Maison de la Bonne Presse, n.d.) Price 1 franc.

THIS little volume gives simply-worded directions for the construction of apparatus that will enable persons interested to make use of the time signals dispatched regularly from the wireless telegraph station at the Eiffel Tower. The author begins with a description of the very simple apparatus required by a Parisian amateur, and gives a clear account, with fully detailed examples, of the time signals and the meteorological messages from the tower. From his story of a day's programme of the tower, including as it does telegraphic exercises with other French stations as well as regular service messages, it would appear that the amateur in the French capital has excellent opportunities of learning Morse with a very small outlay on apparatus.

The next two sections of the book give instructions for erecting a receiving station of sufficient sensitiveness to pick up the messages at distances of two or three hundred miles from the tower. These directions are plain and sufficient. With the apparatus described, a French amateur may listen to a great variety of Spanish, Italian, German, and English messages; and an entertaining programme is made out for him in the book. Here the information conveyed is just such as will help those amateurs who are in a state of mental fog as regards the origin of the signals they listen to, and the information will be almost as useful to English as to French amateurs. The book closes with an account of the system of signalling time adopted by the international conference of October last.

It is intended that different stations shall transmit certain signs at different hours. Those normally audible in England are Paris at midnight and 10 a.m., Norddeich at midday and 10 p.m. At present, it may be remarked, the Paris signals indicate 10.45 a.m. and 11.45 p.m.

The receipt of these time signals is so easy a ıatter that every observatory, and every other ıstitution or person needing accurate time, ought) take advantage of them.

:) *School Gardening, with a Guide to Horticulture.* By A. Hosking. Pp. xi+326. (London: W. B. Clive, 1912.) Price 3s. 6d.

:) *Plant Geography.* By Prof. G. S. Boulger. Pp. viii+136. (London: J. M. Dent and Sons, Ltd., 1912.) Price 1s. net. (The Temple Primers.)

(1) MR. HOSKING has produced a useful book, or rather three small books, under the title of 'School Gardens." The second part deals with soils, manures, and the cultivation of garden crops; while part iii. is devoted to garden pests and miscellaneous information.

Part i., which gives the title to the book, is to us the section of most interest and value, and we would gladly have seen it expanded at the expense of the other portions of the book which require treatment on a more generous scale. On the subject of school gardens the author can speak with a full experience, and his practical details throughout are concise and thoroughly to the point.

The school garden must not be considered in the light of a paying venture. Its value will only appear when the pupils have become settled in life; then the stimulus to observation and method and the interest in outdoor pursuits they received will be fully appreciated, and the experiment will reap sufficient reward.

(2) In the small compass of 136 pages Mr. Boulger has succeeded in compiling a very readable account of plant geography. The four divisions of the book deal with the evolution of the plant world, the factors of distribution, floristic regions, and botanical ecology or topography. He has wisely devoted the larger part of the book to the consideration of factors of distribution rather than to detailed accounts of the floras of different regions, since the science of plant geography is so fundamentally bound up with the proper understanding of the ways and means of plant dispersal.

Mendel's Principles of Heredity. By W. Bateson, F.R.S. Pp. xiv+413. (Cambridge University Press, 1913.) Price 12s. net.

A REVIEW of the first edition of Dr. Bateson's valuable conspectus of discoveries in regard to heredity made by the application of Mendel's methods of research, appeared in NATURE of May 25, 1911 (vol. lxxxvi., p. 407). Since then a vast amount of work has been done upon various subjects of Mendelian analysis; and Dr. Bateson has endeavoured to take account of this by a series of appendices giving descriptive references to papers representing advances upon the state of knowledge when the original volume was published. Short of rewriting the book, this was probably the best means of giving a new lease of life to a standard work upon Mendelism by a leading exponent of its principles.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Spectra of Neon, Hydrogen, and Helium.

IN the issue of NATURE for February 27 (p. 699), Prof. Collie and Mr. Patterson have directed attention to numerous approximate coincidences between lines of neon and hydrogen, from which it is presumably intended to be inferred that certain lines of neon are ordinarily present in the vacuum tube spectrum of hydrogen. A further examination of the observational data, however, seems to be desirable.

Messrs. Collie and Patterson have omitted to state that in the region considered, λ6507 to λ3472, Watson's list of the secondary spectrum of hydrogen contains more than 700 lines, while that of neon contains 260 lines, of which nearly 100 are of intensity 4 or greater. With spectra of this complexity there is nothing at all remarkable in the occurrence of a considerable number of approximate coincidences between lines belonging to the two spectra. As stated by Messrs. Collie and Patterson, there are, in fact, twenty neon lines of intensity 4 and upwards which fall within a quarter of an Angström unit of lines of hydrogen; while, if all the neon lines are included in the comparison, and differences of wave-length amounting to a whole Angström unit be allowed, the number is brought up to 110.

Messrs. Collie and Patterson, however, do not seem to have realised the accuracy of modern spectroscopic tables, such as they have utilised in the present comparison. A difference of more than a few hundredths of an Angström unit in the tabulated wave-lengths of two lines should now suffice to prove that they have different origins, unless other evidence of probable identity is forthcoming. If the permissible discrepancy be reduced to one-twentieth of an Angström unit, there remain only six lines which might be regarded as possibly common to the two spectra, namely:—

Neon			Hydrogen		
Intensity		Wave-length	Intensity		Wave-length
5	...	6175·09	0	...	6175·14
7	...	6143·31	0	...	6143·30
7	...	5343·40	0	...	5343·43
4	...	4537·93	0	...	4537·91
9	...	3520·61	1	...	3520·60
6	...	3472·68	0	...	3472·65

Thus, of the hundred brightest lines of neon, only six are found in hydrogen within the probable limits of error, and only one of the six brightest is among them. There is no evidence that the six "coincident" neon lines have special properties which would favour their survival, and the coincidences cannot, therefore, be properly regarded as significant. Even twenty such coincidences would not prove a relation between the two spectra, unless it could be shown that the lines in question were the most persistent of the neon spectrum.

A very similar result is indeed obtained when a comparison is made between neon and iron. Over the same range of spectrum there are thirteen of the hundred brighter neon lines which differ by no more than one-twentieth of an Angström unit from iron lines, but this would scarcely be accepted as evidence of any relation between the two spectra.

As regards the comparison of neon with helium, the mean deviation of the three lines noted is 0·16, which

is probably considerably greater than can be attributed to errors of measurement. Moreover, helium lines occur in connected series, and there is no justification for supposing that one of them would be represented in the absence of other members of the same series. The oxygen line 5330·84, which, it was pointed out, is nearly coincident with neon 5330·90, is one component of a triplet forming part of a series, and would not appear in the absence of the associated lines.

To my mind the proper conclusion to be drawn from the comparisons is that the respective spectra are quite distinct, and that the approximate coincidences are entirely accidental. A. FOWLER.

South Kensington, March 3.

The Influence of Icebergs on the Temperature of the Sea.

PROF. BARNES, in NATURE of February 20, gives an important piece of information which seems to me to enable us to clear up the confusion at present surrounding this subject, as it explains the reason for the different results obtained by Prof. Barnes in his earlier and later observations, and why his results differ from those of previous observers; and it also helps us to an explanation of the puzzle of the rising temperature of the sea on approaching icebergs, found by Prof. Barnes. The earlier observers made their tests in the cold but weak sea-water floating on the surface. Prof. Barnes's first tests were made at a depth of 5 ft. The first part of his curve, Fig. 1 (NATURE, June 20, 1912), gives the temperatures of the sea as the thermometer passed under the outer edge of the cold surface water, and was thus made in the ordinary sea-water, and gave the temperatures below the cold surface water, until the ship arrived within a mile of the iceberg, where the increasing depth of the cold surface water began to affect the thermometer, and from that distance, the thermometer being now in the cold surface water, the temperature fell rapidly as the ice was approached. The thermometer in Prof. Barnes's second ship, he tells us in his last letter, was placed at a depth of 18 ft. below the surface, and seems to have been always too deep to get into the cold surface water.

We now come to the question as to why these last observations of Prof. Barnes show a constant rise in the temperature of the water as icebergs were approached. We can scarcely imagine ice to have any heating effect, and solar radiation does not seem to meet the case. It would, however, appear that we do not require to call in the aid of sunshine, or other outside source of heat, to explain this rise in temperature, as it can be more simply accounted for by the indraught current near the surface having to dip below the cold surface water, its upper warmer water being thus carried downwards towards the thermometer. By this explanation there is no heating of the water as it approaches the iceberg, but the warmer surface water coming from outside the cold surface area is carried underneath the cold water to lower levels, so giving a rise of temperature at these levels.

If the above explanation be correct it would appear that the surface cold current is the one to be mainly depended on for indicating the presence of ice, because, unless there is some depth of cold surface water, there will be no depression of the inflowing current, and therefore no rise of temperature on approaching the iceberg. Perhaps the best method of observing would be to have two thermometers, one near the surface and the other at a depth of, say, 18 ft., writing on the same paper. Under ordinary conditions these two would show nearly a constant difference, but would tend to diverge on the approach of ice, so checking each other, and magnifying the indications.

JOHN AITKEN.

Ardenlea, Falkirk, February 22.

Systems of Lines obtained by Reflection of X-Rays.

IN continuation of the experiments of Mr. W. L. Bragg (NATURE, December 12, 1912, p. 410), we have investigated the reflection of X-rays by mica and rock salt. In these experiments we found that in general two dark spots are obtained in consequence of the reflection, one of which is crossed by equally-spaced lines, which run at right angles to the plane of reflection. The distance between the different lines increased with increasing distance of the photographic plate from the crystal, and appeared greater with rock-salt than with mica. In some photographs the second spot was also striated.

The plates cut from the crystals were fastened down to aluminium foil 0·2 mm. thick. Successful photographs were only obtained with rays of grazing incidence, an angle of about 80° being used in most cases.

The regularity in which the fringes were distributed suggests that the phenomenon is due to interference. Further experiments are, however, required before this question can be definitely settled. Since Prof. Barkla and Mr. Martyn (NATURE, February 13, 1913, p. 647) have recently described similar results, it may be desirable to publish our preliminary results, of which a more complete description will soon be communicated to the German Physical Society.

E. HUPKA.
W. STEINHAUS.

Physikalisch-technische Reichsanstalt, Charlottenburg, February 23.

Four-horned Sheep in Scotland.

So little seems to be known regarding the early occurrence of Scottish four-horned sheep that the following record will bear repetition. It occurs, almost as an aside, in the account of the parish of Moffat, in the lowland counties of Dumfries and Lanark, published in Sir John Sinclair's "Statistical Account of Scotland," vol. ii., p. 292, 1792. The writer of the account, Rev. Mr. Alex. Brown, says:—"It is not long since the sheep in this part of the country, were of the four-horned kind; a few of which, it is said, remain still in some parts of Nithsdale. Their body is smaller, but their wool finer than those of the present breed. Their want of weight for the butcher, and greater difficulty and danger in lambing have banished them from this place."

This lowland four-horned race agrees with the Hebridean in the characters of fineness of wool and smallness of body. It also appears to agree in the less tangible character of maternal inefficiency, for of an experiment carried out in a small Western Islands' flock in the Isle of Man a few years ago Prof. Wallace says ("Farm Live Stock," p. 521, 1907):—"The animals weighed only 5 lb. to 6 lb. per quarter, and they proved to be such indifferent nurses that they were eventually put away"—causes remarkably similar to those which "banished them" from south Scotland. At any rate, it would seem clear that the four-horned breed of sheep, the last remnants of which in Scotland were isolated on the Hebridean and Western Islands, had at a comparatively recent date considerable outposts on the mainland. JAMES RITCHIE.

The Royal Scottish Museum, Edinburgh, February 26.

THE TRIBES OF NORTHERN AND CENTRAL KORDOFAN.[1]

IN many ways this is a most interesting and suggestive volume, nor can its significance be measured entirely by the number of new and important facts recorded in it. If we except Mr. J. W. Crowfoot's archæological studies, not only is this the first piece of precise work of any magnitude dealing with an ethnological subject produced by an officer in the service of the Anglo-Egyptian Sudan, but since the Government has borne the expense of its publication it furnishes a further example of that enlightened spirit which has already led the Government to find the funds necessary to start an ethnographical survey on a small scale. Considering that the part played by the Sudan Government in the production of this volume is perfectly well known, it is perhaps a pity that the book contains no definite statement on the subject, since its appearance may be looked upon as the first fruits of the sensible forward scientific policy in favour in the Sudan. This, indeed, is the aspect of general public importance with which ethnologists and historians are most concerned.

There is, of course, another point of view, which no doubt specially appealed to the representatives of the Intelligence Department. During the years of residence and travel in Kordofan Mr. MacMichael accumulated a fund of knowledge concerning the quarrels, wanderings, and relationships of both the sedentary and nomad Arab tribes of the province. Part of this had perforce to be acquired as the country was opened up by the new administration, but the remainder of the really vast stores of hitherto unpublished and recondite historical information brought together in this volume was collected as a labour of love, and constitutes a corpus of information concerning the history, sociology, or ethnology of Kordofan. While all interested in these subjects should be grateful, Mr. MacMichael's successors responsible for the present and future administration of the province will most profit by his labours, for it is not too much to say that a collection of facts such as this, put in the hands of an intelligent newcomer and properly used, must reduce the doubts and difficulties of administration by 50 per cent.

Southern Kordofan, Dar Nuba, does not come within Mr. MacMichael's purview; in this he follows the native idea, for neither Arabs nor blacks include Dar Nuba in Kordofan. In spite of this, Mr. MacMichael has rightly included the Baqqara, and he has added to the interest and

A Kabâbîsh camel with "utfa" ready to transport the daughter of the wife of a sheikh from one camping ground to another. (Note the leather work and cowrie shells). From "The Tribes of Northern and Central Kordofân."

scientific value of the book by chapters on Jebel Midob and the little-known Zaghawa. The former is a hill *massif* some forty miles long on about the same latitude as Omdurman, but so far west as to be in Darfur territory. From the details concerning its inhabitants, now for the first time available, there can be little doubt that these non-Mohammedan "black black slaves" (as the

[1] "The Tribes of Northern and Central Kordofân." By H. A. MacMichael. Pp. xv+259. (Cambridge University Press, 1912.) Price 10s. 6d. net.

Kababish called them to the writer) are the surviving representatives of the old Nuba population of the hills of northern Kordofan, the remains of whose houses can be seen on so many hills. In spite of the contemptuous tone taken by the nomad Arabs when speaking of these folk, they are bold raiders, and do not hesitate to cross the border to lift the cattle and camels of even the strongest tribes, the herdsmen of which they kill or enslave as opportunity offers.

The Zaghawa are Hamiticised negroids who about the end of the eighteenth century emerged as a vassal State in northern Darfur under practically independent rulers. It was probably about this time, or a little earlier, that a party of Zaghawa migrated eastwards and seized the hills in the neighbourhood of Jebel Kagmar in northern Kordofan, where they settled and which their descendants still occupy, though none of these can speak a word of any language but Arabic, and have adopted a pedigree dating back nineteen generations to Khalid el Guhani, the brother of Abdulla el Guhani, to whom the usual faked *nisba* of the tribes of the northern Sudan goes back.

The mere mention of these two matters will serve to give some idea of the value and scope of the book.

A MEMORIAL TO SIR JOSEPH HOOKER.

A MEMORIAL to the late Sir J. D. Hooker, which has been placed in the Parish Church at Kew, near the similar memorial to his father, Sir W. J. Hooker, was unveiled by Lady Hooker in the presence of members of the Hooker family on Saturday, February 22. The memorial consists of a mural tablet of coloured marble bearing the following inscription:—

1817–1911 JOSEPH DALTON HOOKER, O.M. G.C.S.I. C.B. M.D. D.C.L. LL.D., ASSOCIÉ ÉTRANGER OF THE INSTITUTE OF FRANCE, KNIGHT OF THE PRUSSIAN ORDER "POUR LE MÉRITE," SOMETIME PRESIDENT OF THE ROYAL SOCIETY, FOR XX YEARS DIRECTOR OF THE ROYAL BOTANIC GARDENS KEW. BORN AT HALESWORTH 30TH JUNE 1817, DIED AT WINDLESHAM 10TH DEC. 1911. THE WORKS OF THE LORD ARE GREAT SOUGHT OUT OF ALL THEM THAT HAVE PLEASURE THEREIN.

Below this inscription is a Wedgwood medallion portrait of Sir Joseph, flanked and supported by five panels containing Wedgwood figures of plants with which, in the course of his long career, there had grown up some especial association. In the upper and corner panels, left and right, these plants are an Aristolochia, commemorating his connection with African floristic work and travel, and a Nepenthes, recalling a notable contribution to our knowledge of vegetable morphology and physiology. The left lower corner panel contains a Cinchona, commemorating Hooker's connection with one of the most humane episodes in economic botany during his lifetime—the introduction to south-eastern Asia of the medicinal Cinchonas of South America. The panel which balances this on the right contains a Rhododendron, commemorative of Hooker's great Himalayan journey.

In a smaller central panel between the lower corner ones is a Celmisia, recalling the southern voyage with Ross and the labour bestowed on the flora of New Zealand. At foot are the family arms with the family motto and the motto of the Most Exalted Order of the Indian Empire, of which Hooker was a member in the highest grade. The portrait, a head profile to left, is the work of Mr. Frank Bowcher, and is an excellent likeness, recalling the same artist's treatment of his subject in the medallion executed in 1898 at the instance of the President and Council of the Linnean Society to record the completion of Hooker's "Flora of British India" and his sixty years' services to science.

SIR WILLIAM HENRY WHITE, K.C.B., F.R.S.

BY the sudden death of Sir William White on February 27, at sixty-eight years of age, the country has lost one of her best sons and engineering science one of its leading authorities. Sir William White was born at Devonport in 1845, and started his professional life by leaving a private school in the town, in which he was at the time "head boy," and becoming a shipwright's apprentice in Devonport Dockyard.

In the fullest sense of the term the boy was "father to the man," as on entering the dockyard he occupied the highest position among those entering with him, a position which he not only maintained but improved upon by rapidly becoming higher than apprentices who had been entered before him and had had longer practical training and longer education in the dockyard school.

In 1864 a Royal School of Naval Architecture and Marine Engineering was founded at South Kensington, and to this eight shipwright apprentices were appointed, of whom Sir William was the first in order of merit. Of these only one, viz. Mr. H. E. Deadman, C.B., who was principal assistant to Sir William on his retirement from Admiralty service, now survives.

During his study at South Kensington Sir William uniformly kept highest in order of merit, and although some of his college mates, notably the late Dr. F. Elgar, formerly Director of dockyard work at the Admiralty, Mr. W. John, of Lloyd's Register, Mr. W. J. Bone, of Newcastle, and Mr. H. E. Deadman, mentioned above, achieved great distinction, it fell to the lot of Sir William to be called upon to undertake still higher work, and this work he carried out most successfully under trying conditions, often involving shortness of Admiralty staff and inadequacy of office accommodation.

On completing, in 1867, his training at South Kensington, Sir William joined the Admiralty Constructive Staff, under the headship of Sir Edward Reed, K.C.B., and at once threw himself with his characteristic zeal into all of the many difficult matters existing at that time of changing

from wood shipbuilding to iron and steel shipbuilding and from unarmoured to armoured ships.

At this time the principal problems before the Admiralty naval architects were:—(1) What was the best method of constructing the armoured side of ships of the line; (2) what was the best method of disposing the armament; and (3) whether on the whole it was more advantageous to build a comparative short vessel like Sir Edward Reed's *Bellerophon*, notwithstanding the cost in machinery and coal involved in propelling each ton of her displacement, or to build such long fine-lined vessels as the *Warrior* and *Minotaur?*

Even at this early stage of his career Sir William threw much light on these questions, and, in addition, was of the utmost assistance to Sir Edward Reed in the preparation of his famous book, "Shipbuilding in Iron and Steel," published in 1869.

In 1870 Sir Edward Reed retired from his position of Chief Constructor of the Navy, and a Council of Construction, with Sir N. Barnaby (then Mr. Barnaby) at its head, was appointed to carry on the work of Admiralty naval construction. So valuable had been the work of Sir William White in the short time he had been at the Admiralty that he was retained in the position he had served in under Sir Edward Reed, and was gradually entrusted with more and more important work involving a continually increasing amount of responsibility on his part, and from then to the time of his leaving the Admiralty service in 1883 to become the head of the war shipbuilding department of Sir W. G. Armstrong and Co., at Elswick-on-Tyne, there was no work done by the Admiralty designing staff in which he did not play a very large part, which in many cases was a leading part.

In 1871 he read his first paper before the Institution of Naval Architects, which had been prepared by him with the assistance of Mr. W. John named above, and was entitled, "On the Calculation of the Stability of Ships, and Some Matters of Interest Connected Therewith."

This reading of papers before the Institution of Naval Architects he kept up for many years. They were always of first-rate importance; many of them dealt with semi-naval matters as distinct from matters of naval architecture; and the views he put forward were always met with the greatest respect. In addition to beginning in this period the contribution of papers to the Institution of Naval Architects, he commenced taking part in the discussion of papers read by other persons at the same institution, his first effort in this direction being in 1875 with respect to a paper by Mr. William Froude on the graphic integration of a ship's rolling, including the effect of resistance.

During the period of 1869–83, now under consideration, Sir William much interested himself in the education of young naval architects, and almost immediately on his appointment to the Admiralty Office in 1869 he was appointed to succeed Mr. Crossland, a member of an earlier school of naval architecture, as lecturer on naval designing at the South Kensington school. This position he retained for some years after the transfer of the South Kensington School to Greenwich, where the school still exists.

While holding this position he, in conjunction with Dr. T. Archer Hirst, the Director of Studies at Greenwich, arranged a course of instruction in naval architecture for the benefit of executive naval officers, and the syllabus of instruction was so well chosen and so wisely given effect to under his guidance that large numbers of officers were attracted to the classes, and the classes continue in effective operation to this moment.

He also at this time put forward a well-considered scheme for the formation of a Royal Corps of Naval Constructors to replace the heterogeneous system then in force, and after some amount of consideration on the part of the then Controller of the Navy, Sir W. Houston Stewart, K.C.B., and of a committee appointed for the purpose and presided over by Sir T. Brassey (now Lord Brassey), the Crown in 1883, under an Order in Council, graciously created the corps on the footing it still holds.

The chief designing work on which Sir William was engaged in this earlier period of Admiralty work, viz. 1869–83, was that of the famous *Inflexible*, with two turrets in *échelon* each containing two 16 in. muzzle-loading guns. The design of this vessel excited very strong adverse criticism, led by Sir Edward Reed. A specially competent committee was appointed to report on the design, and after long and exhaustive investigation—much of it of a practical nature at sea on actual ships, and in the experimental works of Mr. Froude—the committee reported that the design fully satisfied the conditions it set out to meet.

This design was repeated on a smaller scale by two vessels, the *Ajax* and *Agamemnon*, and by two somewhat larger, viz. *Colossus* and *Edinburgh*, although these were still much smaller than *Inflexible*. On all these vessels Sir William took a very prominent part, introducing into *Colossus* and *Edinburgh* for the first time in our line of battleships the construction of the hull of the vessel of steel instead of as heretofore of iron.

From 1883 to 1885 Sir William was engaged on warship design and was head in all respects of the warship-building branch of Messrs. Sir W. G. Armstrong and Co. at Elswick-on-Tyne. He there designed and laid down several famous vessels for foreign Powers, and laid out the Elswick shipyard for warship-building in a manner securing the utmost efficiency for building purposes.

On the expiration of this period he was appointed by Lord George Hamilton, then First Lord of the Admiralty, as Director of Naval Construction in succession to Sir N. Barnaby, then retired on account of ill-health. It has long been recognised that no wiser choice could have been made; and then commenced that portion of the work of Sir William best known to the public, although it will be seen by what has been stated above that he had already a large and very varied amount of work to his credit.

To deal adequately with the work of Sir William

as Director of Naval Construction would be little short of writing a volume; and cannot be attempted here.

On rejoining the Admiralty in 1885, Sir William at once set about making improvements and developments in all classes of designs so as to embody in them all the improvements continually being made in guns, armour, and propelling machinery. Limitations of space will not permit us to describe the various type of vessels which received considerable development under his hands, and mention can be made of one or two points only.

As regards battleships, he made a special study of all the elements which go to make for fighting efficiency, having regard to the rapidly changing concurrent general features of the engineering world, and in 1889 wrote a famous paper for the Institution of Naval Architects, giving quite frankly all his views of the subject, and stating the points that had decided the Board in ordering the then new ships the *Empress of India* and her sisters. He was much criticised by many members, but it was generally felt that his views were sound. In principle and in main features they were adopted, with such extension as arose from the general increase in size and cost of ships up to the introduction of the *Dreadnought* type of ship.

Sir William received many distinctions. He was honorary vice-president of the Institution of Naval Architects, and past president of the chief engineering societies and honorary member of many others. He was elected a Fellow of the Royal Society in 1888, and was created K.C.B. in 1895. At the time of his regretted death on Thursday last he was the president-elect of the British Association for the meeting to be held at Birmingham next September, and his loss to the association will be severely felt. His name will ever be remembered in the annals of the British Navy and the records of engineering science.

PROF. ADAM SEDGWICK, F.R.S.

THE late Prof. Sedgwick was grand-nephew of Adam Sedgwick, Woodwardian professor in the University of Cambridge from 1818 until 1873, sometimes known as the "old Adam." Their ancestors had been "statesmen" in the Dale of Dent for several centuries. Adam Sedgwick, jun., was the son of Richard Sedgwick, vicar of Dent, and the affection he always bore towards his native valley was evidenced by the fact that he sent his second boy to the school at Sedbergh, at the mouth of the Dale.

Our Adam was born in 1854 at Norwich, where his great-uncle held a canonry. He was educated at Marlborough College, and after a short time at King's College, London, he entered in 1874 Trinity College, Cambridge. At that time the recently established professorship of zoology and comparative anatomy was held by Prof. Newton, and Mr. J. W. Clark was superintendent of the Museum of Zoology. Prof. (afterwards Sir George) Humphrey was professor of anatomy, and Michael Foster had recently come to Cambridge as prælector in physiology to Trinity College. A demonstrator in comparative anatomy had just been appointed by the University, and the late Prof. Bridge was the first to hold that office; a curatorship of the Strickland collection of birds was founded in the year that Adam Sedgwick came into residence, and Mr. O. Salvin was the first Strickland curator. It has not always been recognised that Cambridge led the way in the practical teaching of zoology and biology. Three years before Adam Sedgwick came into residence, J. W. Clark had, with the aid of his friend Mr. Bridge, started laboratory work in these subjects. This class-work was carried on with renewed activity by Milnes-Marshall and by Frank Balfour, and by the time that Adam Sedgwick began to be interested in zoology and to be influenced, as he was for life, by Balfour, practical classes were in full working order, although conducted in adverse circumstances of space and equipment.

Sedgwick was placed in the first class of the natural sciences tripos in the year 1877. In the same list were the names of Prof. Bower, of Glasgow, Dr. Fenton, of Christ's, and Dr. Alex. Hill, of Downing. Compared with the modern days, the tripos was insignificant in numbers, but modern days may not find it easy to equal the quality of this list. After taking his degree Sedgwick definitely cast in his lot with zoology. In 1880 the zoology class conducted by Balfour, with Sedgwick as assistant, was held in the room now occupied by physiological chemistry, at the top of Fawcett's building overlooking Corn Exchange Street.

The University was so conscious of Balfour's ability that, in 1882, he was appointed professor of animal morphology, it being understood that the professorship would lapse with his death, and that it carried but a small emolument with it. The tragedy in the Alps the same year brought this professorship to an end, and Sedgwick was left in a peculiarly difficult position. He had but recently taken his master's degree, he was but little older than some of the senior students, and the management of a comparatively large and rapidly growing department devolved on him.

Before the beginning of the October term of the same year Prof. Newton, Michael Foster, Prof. Humphrey, and J. W. Clark addressed a letter to the Vice-Chancellor, urging that the work which Balfour had so wonderfully begun should be carried on, and that the general supervision of the class should be entrusted to Sedgwick, who had been Balfour's demonstrator for some years, and had been in charge of the class during the Lent and May terms, when Balfour had been either ill or away. This was arranged, and Sedgwick was happy in securing the assistance of Mr. W. Heape, of Trinity College, and Mr. W. R. F. Weldon, of St. John's, as demonstrators, and a little later on of Mr. W. H. Caldwell, of Caius, who was then, with the aid of Mr. Threlfall, of the same college, at work on their automatic microtome.

The University was anxious to assist Sedgwick

in every way in carrying on his difficult task. At the time of Balfour's death it was already building a spacious laboratory and private rooms adjoining it to accommodate students of zoology. Owing to the rearrangement of the M.B. examination, further increase soon became necessary, and this the University provided in 1884 by bodily lifting the roof off the Mineralogical Museum and building up walls under it.

Whilst Prof. Newton kept alive in the University the study of zoology as a study of living animals, Sedgwick promoted the interest of those more interested in the architecture or morphology of the animal body. He had become in 1880 a Fellow, and soon after lecturer at Trinity College, and the college (as is the habit of Cambridge colleges) allowed his University lectures to count as though they were delivered to, as they were paid for by, the college.

Sedgwick's first researches, as was natural, were on embryology, and were mainly concerned with the origin of the vertebrate kidney. He also published a short paper on Chiton, with two useful diagrams, but the work by which he will be longest remembered was his investigation into the embryology and anatomy of the Cape species of Peripatus. His investigations did much to clear up the nature of the body-cavity of the Arthropods, and to explain what had become of the cœlom in the members of this group. What he found in the developing egg of Peripatus started him on more than one interesting speculation. His views on the cell-theory, at one time much criticised, have largely come into their own. Another of his ingenious hypotheses largely based on the same research related to the origin of segmentation in metameric animals. At one time he had contemplated a final volume to his "Zoology," which was to deal with the theory and philosophy of the science, and it is very greatly to be regretted that this has not appeared. His originality of outlook and power of expression would have made it a valuable contribution to the more speculative side of zoology.

As a result of his work on Peripatus, he was elected a Fellow of the Royal Society in 1886, and he twice served on the council of that body. In 1897 he became tutor at Trinity College, and for ten years held that position. Although he continued with his usual vigour the teaching and management of a great department, this appointment practically coincided with his ceasing research. It also coincided with the production of what is undoubtedly the most comprehensive text-book in English written, with the exception of one or two groups, by one man. Sedgwick's aim in his great text-book was to mention practically every genus. Of course, in some groups, such as the insects, this ambition could not be realised; but his broad outlook, his wide knowledge, and, on certain lines, his philosophical insight have made the book invaluable to all advanced students of the subject. It will be, with his work on Peripatus, a lasting memorial to his name.

In 1907 Prof. Newton died, and the chair of zoology then passed to Adam Sedgwick, who for so many years had been the head of the department of morphology. To the great regret of his Cambridge friends he only held it for two years. In 1909 he accepted the post of professor of zoology at the Imperial College of Science and Technology, and for the last three and a half years he spent his whole energies in the attempt to build up a school of zoology in South Kensington.

For some months his friends had marked with dismay a serious decline in his health, but his sudden death on February 27 came as a shock to many who read of it in their morning paper last Friday.

If one may say a few words about his personality, he was extraordinarily "alive," very trenchant in his criticisms, not a good lecturer, the reverse of fluent, yet by his earnestness and by the vigour of his language arresting attention. Still he was a successful teacher. The best course he gave was that on embryology; here he was giving his class the results of first-hand, personal knowledge, and his students felt they were listening to a master of the subject. His very entrance into the great laboratory where some hundred students were being taught by eight or ten demonstrators put a new spirit into the thing. The atmosphere, as it were, became electrified, and teachers and taught were "keyed up." As a conversationalist he was most interesting, holding often bizarre and impossible views, and maintaining them with extraordinary energy and humour. If one may judge by portraits and statues, he was in physique very like his great-uncle—small and frail in body, his face was quick and keen. Like his great-uncle again, he was an eager and rapid worker, one who never spared himself when working at the subject to which he devoted his life.

NOTES.

The following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Prof. V. H. Blackman, professor of plant physiology and pathology at the Imperial College of Science and Technology; Dr. William Bulloch, professor of bacteriology in the University of London; Mr. D. L. Chapman, fellow and tutor of Jesus College, Oxford; Prof. W. E. Dalby, professor of civil and mechanical engineering at the Imperial College of Science and Technology; Dr. T. R. Elliott, lecturer in practical medicine at University College Hospital Medical School; Prof. J. C. Fields, professor of mathematics in Toronto University; Dr. J. S. Flett, assistant director of the Geological Survey of Scotland; Prof. J. P. Hill, Jodrell professor of zoology and comparative anatomy at University College, London; Mr. A. R. Hinks, chief assistant at the Cambridge University Observatory; Prof. F. Keeble, professor of botany in University College, Reading; Prof. A. Keith, Hunterian professor of the Royal College of Surgeons; Dr. K. Lucas, lecturer in natural sciences, Trinity College, Cambridge; Prof. O. W. Richardson, professor of physics in Princeton University; Dr. W. Rosenhain, superintendent of the metallurgical department of the

National Physical Laboratory; Mr. G. W. Walker, formerly superintendent of the Eskdalemuir Observatory.

THE Secretary of State for India in Council notifies that one appointment to the Indian Geological Survey Department will be made in July next. A further vacancy is expected to occur in the year 1914.

THE Rome correspondent of *The Times* states that the Italian Geographical Society proposes to give a gold medal to Capt. Scott's family and two silver medals respectively to the families of Dr. Wilson and Capt. Oates.

THE death is announced, in his eighty-fifth year, of Dr. S. A. Lattimore, professor of chemistry at the University of Rochester, N.Y., from 1867 to 1908. As a young man he spent ten years as a classical tutor and then professor of Greek at his *alma mater*, a university in Indiana. Having then decided to adopt a scientific career, he became professor of chemistry at Genesee College, where he served for seven years before his appointment at Rochester.

THE death is announced, at the age of ninety-one, of Major-General Henry Clerk, R.A., F.R.S. General Clerk was elected a fellow of the Royal Society so long ago as 1848, and he served on the council in the years 1878-80. He was the author of papers on meteorological and magnetic observations made in a voyage to the Antarctic circle, and also of papers on the strength of timber, friction, and the flow of liquids through small orifices.

FOR the meeting of the British Association which will take place in Birmingham on September 10-17 next, the following sectional presidents have been appointed:—A (Mathematics and Physics), Dr. H. F. Baker, F.R.S.; B (Chemistry), Prof. W. P. Wynne, F.R.S.; C (Geology), Prof. E. J. Garwood; D (Zoology), Dr. H. F. Gadow, F.R.S.; E (Geography), Prof. H. N. Dickson; F (Economics), Rev. P. H. Wicksteed; G (Engineering), Mr. J. A. F. Aspinall; H (Anthropology), Sir Richard Temple, Bart.; I (Physiology), Prof. F. Gowland Hopkins, F.R.S.; K (Botany), Miss Ethel Sargant; L (Education), Principal E. H. Griffiths, F.R.S.; M (Agriculture), Prof. T. B. Wood.

MR. R. J. BALSTON, of Maidstone, has presented to the British Museum (Natural History) his well-known collection of humming-birds. The birds are mounted and arranged in forty-nine cases, each of which contains a group of two or more species. The total number of specimens in the collection is stated in Mr. Balston's MS. to be 3315, representing 162 genera and 480 species. Of these, 2674 are skins, and 199 nests, some of the latter containing eggs. As soon as arrangements are made for its reception the series will be placed on exhibition in one of the corridors on the first floor of the zoological department. This collection and the Gould collection will render the exhibited series of humming-birds one of the finest, if not actually the finest, in the world.

THE thirty-fifth annual general meeting of the Institute of Chemistry was held on Monday, March 3. Prof. R. Meldola, F.R.S., occupied the chair, and in the course of his presidential address he remarked that the applications of chemistry in every field of human activity have been steadily increasing, and the importance of professional chemists to the public welfare is becoming more and more recognised. Professional chemists have not secured that full measure of public recognition to which they are entitled, but in this country all scientific affairs move but slowly. The consolidation and the elevation of the profession and the maintenance of the status of the chemical practitioner will become more and more determined in the future by the standard of efficiency and of conduct set up by the fellows and associates. Until the whole level of public appreciation of the value of this profession is raised, the country is destined to lose the services of that highest type of cultured and trained chemist of which other nations are more wisely availing themselves, to our detriment and their advantage.

THE following are among the lecture arrangements at the Royal Institution, after Easter:—Dr. A. S. Woodward, two lectures on recent discoveries of early man. Prof. W. Bateson, two lectures on the heredity of sex and some cognate problems. Prof. W. Stirling, three lectures on recent physiological inquiries. Prof. T. B. Wood, three lectures on recent advances in the production and utilisation of wheat in England. Dr. E. Frankland Armstrong, two lectures on (1) the bridge into life; (2) colour in flowers. Prof. J. Garstang, three lectures on the progress of Hittite studies. Prof. W. J. Pope, three lectures on recent chemical advances. Mr. H. A. Humphrey, two lectures on Humphrey internal-combustion pumps. Prof. E. Rutherford, three lectures on radio-activity. The Friday evening meetings will be resumed on April 4, when Mr. J. J. Dobbie will deliver a discourse on the spectroscope in organic chemistry. Succeeding discourses will probably be given by Mr. C. J. P. Cave, Dr. T. M. Lowry, Prof. J. Garstang, and Mr. H. G. Plimmer.

As has been pointed out already in these columns, March 19 will be the centenary of the birth of David Livingstone. The event is being and will be commemorated in a variety of ways. On February 27 the University and town of Cambridge held a meeting at the Senate House, when speeches on Livingstone's work were delivered. Livingstone College, Leyton, E., has published, as a souvenir of the centenary, an illustrated brochure, entitled "Memorials of David Livingstone"; it contains two portraits of the explorer in colour and other pictures and extracts connected with his work. Livingstone College was founded in the year 1893, in order to give instruction to foreign missionaries in the elements of medicine and surgery, and constitutes a permanent memorial to Dr. Livingstone in the neighbourhood of London. It is now appealing for a sum of 10,000*l*. in order to meet various needs, one of which is to clear off a mortgage of 3500*l*.; 1500*l*. is needed for making certain improvements, whilst it is desired to raise 5000*l*. as the nucleus of an endowment.

AN eighteenth-century picture, which is said to be a portrait of Gilbert White of Selborne, has lately

come to light. Referring to this discovery, Mr. Wilfred Mark Webb remarked, at a meeting of the Selborne Society on March 3, that it was believed that no portrait of Gilbert White existed or had ever been painted. There was, he said, a reason for believing this, in view of the fact that Gilbert White was marked with smallpox, and would probably therefore not wish his appearance to be recorded. Still, the picture, which had been found in the Caledonian Market, and had come into the possession of a relative of one of the members of the society, showed internal evidence suggesting its possible authenticity. The stretcher, canvas, and frame indicated the date, about 1770, when Gilbert White was fifty years of age, and the portrait fitted that age. It also had a family likeness to the portraits of John White and Thomas White. There was a tablet on the picture stating it to be a portrait of Gilbert White, but this had been added when the painting was twenty years old. It was intended if possible to trace the history of the picture, but this would be difficult, though it had once come into a sale-room in London and had been withdrawn. Mr. Webb preferred to await investigation before expressing an opinion.

IN the course of a lecture on heredity in feeblemindedness, delivered at the Galton Laboratory, University College, London, on March 4, Dr. David Heron showed a long series of pedigrees to illustrate various phases of mental defect, and said that there can be no doubt that it is a hereditary character. When, however, attempts are made to discover precise laws of inheritance, many difficulties are encountered, due to the fact that the term "mental defect" covers a multitude of conditions, each of which exists in an almost infinite number of grades of severity. Dr. Heron severely criticised some recent attempts to apply Mendelism to such cases, and showed that the evidence cited told strongly against the theory. What is specially required at the present time is more information. Special efforts ought to be made to follow up the children who are passing through the special schools for the mentally defective, and also to trace back the school histories of those who are now mentally defective criminals and paupers. Much yet remains to be discovered regarding the inheritance of mental defect, but on the basis of our present knowledge it may be asserted that a substantial reduction in the numbers of the mentally defective could be obtained by cutting off the supply at the source—by preventing the feeble-minded from reproducing their kind.

FEBRUARY was generally mild and dry, the rainfall in parts of England being less than one-half of the average. At Greenwich the mean temperature for the month was 41°, which is nearly 2° above the average, but is 2° colder than in February last year. There were during the month ten nights with frost in the shade, whilst on the grass open to the sky there were twenty-one frosts at Greenwich, and on the three consecutive nights from February 22 to 24, the exposed thermometer fell below 20°. The mean of the highest day readings was 47°, and the mean of the lowest night shade readings 35°. The duration of bright sunshine at Greenwich was fifty-eight hours, which is five hours more than the average for the last thirty years. The aggregate rainfall for the month was 0·80 in., which is 0·69 in. less than the average of the last sixty years, and at Kew Observatory the total rainfall was only 0·73 in., which is 0·86 in. less than the normal, and only 0·09 in. of rain fell in the last nineteen days of the month. At Greenwich the mean temperature for the three winter months was 42·5°, which is the same as the mean for the winter of 1911–12, but warmer than in any of the eight previous winters. The rainfall for the winter was about an inch in excess of the average, and February was the only dry month of the three.

THE alpine flora of Japan is to be made the object of special investigation by the Tokyo College of Science, which is establishing a large botanical garden for the purpose at Nikko, situated in a region of high mountains. The Tokyo *Asahi* of January 24 devotes considerable space to an account of the new enterprise, which is intended as a complement to the two gardens, representing the temperate zone and the tropics respectively, laid out by the college some years ago elsewhere in Japan. The site for the new garden was acquired some four or five years ago, and the necessary adaptations and arrangements are expected to be completed early in the summer of the present year. The buildings erected in the enclosure comprise a laboratory, a residential building for students, experimental greenhouses, &c. The garden is to be divided into eighteen sections for the separate cultivation of all varieties of mountainous flora, ranging from trees and shrubs to ground-plants and lichens, and including foreign as well as local growths. Dr. H. Komatsu has been placed in charge of the new station, to which the large collection of alpine species already acquired by the college, but hitherto restricted through lack of accommodation, will be transferred in due course.

BY the death of Mr. George Harold Drew at the age of thirty, which occurred suddenly at Plymouth on January 30, a worker of great promise has been lost to science. Intending in the first instance to qualify for the medical profession, Mr. Drew studied for this purpose at Cambridge, where he was a scholar of Christ's College, and subsequently at St. Mary's Hospital, London. He, however, never completed his medical course, and devoted himself to biological and pathological research, in which he displayed exceptional aptitude. After working for a short time at the Port Erin Laboratory, he settled at Plymouth, where, at the Marine Biological Laboratory, the greater part of his research work was done. For three years he held a Beit memorial fellowship, and he was last summer appointed John Lucas Walker research student in the University of Cambridge. He made two journeys to the United States and the West Indies for the purpose of carrying out researches in connection with the Carnegie Institution. On the purely scientific side, Mr. Drew's best work was on the development of Lamminaria and on the physiological action of marine bacteria, more particularly on denitrifying bacteria and their power of precipitat-

ing calcium carbonate. His pathological work was all undertaken with reference to the problem of cancer. He commenced by a study of the effect of transplanting tissues in invertebrates, and subsequently extended his researches to fishes, where he investigated the effect of repeated stimulation of the tissue by chemical reagents. During the short time he held the John Lucas Walker studentship he was engaged, with much success, in the culture of tissues from the frog and the dogfish in plasma outside the body of the animal.

A PAPER read recently before the Royal Statistical Society by Prof. E. C. K. Gonner, on the population of England in the eighteenth century, was of interest both historically and geographically. In the first part an analysis, in considerable detail, was furnished of the sources available for estimating the population before the "unfortunate superstition which delayed the taking of a census" was removed from the public mind, and of the controversy which occupied the pens of contemporary investigators. By means which he fully set forth, the author then arrived at conclusions which justified him in presenting comparative maps of the density of population in England in 1700, 1750, and 1801, which, while greatly generalised and based only on county areas, show several features of the highest interest. To take one case, the early establishment of a dense population in Lancashire, contrasted with its later establishment in the midland industrial area, and still later in the West Riding of Yorkshire, forms a series of facts which clearly emerges on the maps. Throughout the period there is visible the tendency of the present industrial areas to take their places above the purely agricultural areas in the list of relative density of population, although the population of the agricultural areas by no means declined. The results so accurately parallel the history of these areas at the period that the author's conclusions and his use of authorities are clearly justified.

No. 17 of the sixtieth volume of Smithsonian Miscellaneous Collections is devoted to notes by Mr. A. H. Clark on the American species of Peripatus, with a list of the known New World representatives of the group.

THE Agricultural Department of India has issued a further instalment, in its Memoirs, of the life-histories of Indian insects; this contribution, which is by Mr. G. R. Dutt, dealing with parasitic and other Hymenoptera. In the case of some of the Mutillids, or "velvet ants," it has not yet been ascertained how many species they may affect parasitically, and as this may have an important economic bearing inquiries are to be set on foot with the object of filling this gap in our knowledge.

IN an interesting and fully illustrated report of an expedition to Arctic America, published in the January issue of *The American Museum Journal*, Mr. R. M. Anderson states that the musk-ox was exterminated by Eskimo in the neighbourhood of Franklin Bay about fourteen years ago, and that the species is also practically killed off in the district around the east end of Great Bear Lake. The barren-ground caribou and the white sheep have likewise suffered severely at the hands of natives armed with modern weapons, although small numbers of the latter are still to be found near the sources of every river from the Colville to the Mackenzie, which probably formed the limit of its range.

MESSRS. J. G. O'Donoghue and P. R. H. St. John have published in *The Victorian Naturalist* (January, 1913) some notes on the vegetation and bird-life of the Brisbane Range, in continuation of their earlier work on the natural history of this little-known Australian locality. The prevalence of the gum-tree saw-fly in this area may be judged from their mention of a sapling of *Eucalyptus rostrata* which actually drooped with the burden of five large masses of the larvæ of this insect. Among other items of these interesting notes, mention may be made of the extraordinary activity of small red ants in the transport of the seeds of acacias, evidently for the sake of the oily appendage (caruncle), which the ants bite from the seed, leaving the latter in great masses outside the nest. Brief references are made to the various types of vegetation associated with different soils and physiographic aspects, but it is greatly to be hoped that Victorian botanists will make a detailed ecological investigation of what appears to be an area of unusual interest from this point of view.

PROF. F. W. OLIVER has contributed to *The Gardeners' Chronicle* (No. 1364, February 15) an extremely interesting account of the new nature reserve at Blakeney, Norfolk. The extensive area of waste maritime lands known as Blakeney Point, which has been presented to the National Trust, is to be preserved as a place for the study of wild nature, its acquisition having been made primarily on scientific grounds rather than on account of its scenic or historic interest, though it is fully entitled to rank as a place of great natural beauty. As Prof. Oliver has shown in his recent article in *The New Phytologist*, Blakeney Point shows to perfection the operation of the sorting mechanism by which new ground is built up from the spoils won by the sea from the land, and brought back by an orderly process in the form of shingle, sand, and mud, and also the colonisation of this new ground by plants appropriate to its kind. The distinctive features at Blakeney are the profusion in which developmental stages of all the maritime plant-communities abound, and the rapidity with which change in each sort of terrain is being accomplished. Apart from its ecological interest, the Point is famous as a breeding ground for wild seafowl, and as a place of call for winter migrants, while in many and various respects the fauna generally is full of interest, especially with reference to the important and sometimes surprising relation of the insects and the rabbits to the plant population.

THE liability to drought in India as compared with that in other countries is the subject of an interesting paper by Dr. G. T. Walker in the Memoirs of the Indian Meteorological Department (vol. xxi., part v.). The paper is a preliminary attempt to deal with the matter from an examination of the annual records,

owing to want of details for some countries. A tabular statement gives for a number of stations for which long series of observations were available the normal rainfall and the percentage of years with deficiency (1) between 30 and 45 per cent., (2) between 45 and 60 per cent., and (3) more than 60 per cent. In India places on the coast usually fare better than those in the interior; but burning sun and hot-dry winds during a long break in the rains do much more harm than in some other countries. In the United States, *e.g.* a deficiency of rain produces nothing like the damage that it does in India, while in Europe the liability to failure in the crops is not in the least comparable with that of India. In South America, Brazil and the Argentine Republic show nothing worse than a few cases of deficiency between 30 and 45 per cent., but in Chile, Santiago shows a considerable number of cases of deficiency in the three classes above mentioned; in some parts of Chile there may be a year without any rain whatever.

THE January number of the American journal *Good Lighting* contains an article by Prof. Gotch, of Oxford, which gives a valuable summary of our present knowledge of the properties of the eye when used for detecting and observing distant coloured lights, such as are seen at sea. The normal eye under such conditions recognises a red light as red over an area of the retina the radius of which is three or four times that over which a green light is recognised as green. Outside this area the red light is not seen at all, while the green light outside its area of recognition is seen as a bright white light. In view of these facts, Prof. Gotch suggests that in the absence of binoculars, on which in practice the recognition of the colour of a distant light depends, it should be noted whether the light, apart from its colour, is seen better by oblique than by direct vision; if so, it is a green or white light. If it is seen better by direct than by oblique vision it is red.

RED BOOK No. 176 of the British Fire Prevention Committee deals with tests made on a new celluloid substitute, intended to reduce the risks of fire from the use of kinematograph films. The material was "Cellit," which is an acetyl-cellulose, manufactured by the Bayer Company, Ltd., and resembles celluloid in all respects except that it is far less inflammable and appears to be practically free from the dangers which attend the use of celluloid. As the result of stringent tests to which it was subjected, the material was awarded the committee's certificate of "non-flaming." A copy of the report can be obtained from the secretary of the committee, 8 Waterloo Place, Pall Mall, S.W.

The Engineer for February 28 contains an account of an automatic electric light plant manufactured by Messrs. R. A. Lister and Co., Ltd., of Dursley, Gloucestershire. This plant is intended for private house installations, and consists of a petrol engine, dynamo, automatic starting switch, and water tank, the whole being mounted on two cross girders providing facility for setting down and removal. A small battery is supplied, of capacity very much below that of our ordinary private electric lighting plant. When the battery is charged and no lights on, the engine is at rest. If lights are switched on in number below that capable of being dealt with by the normal discharge of the battery, the engine remains at rest until the battery voltage drops to a certain value. On this voltage being reached, current is automatically sent through the dynamo, and runs it as a motor, thus starting the engine, an operation facilitated by the exhaust valve being automatically held open. When the battery is sufficiently charged, the engine stops again. The engine will also start and keep running if the demand is higher than that which can be dealt with by the battery alone. Exhaustage of the battery by reason of failure of the engine to start when required is prevented by a time-limit circuit-breaker, which allows starting current to pass through the dynamo for a limited period only. The whole arrangement seems likely to minimise the troubles which occur in small lighting sets owing to improper handling of the batteries.

THE issue for 1912 of the "Year-Book of the Scientific and Learned Societies of Great Britain and Ireland" has now been published by Messrs. Charles Griffin and Co., Ltd. It is described on the title-page as a record, compiled from official sources, of the work done in science, literature, and art during the session 1911–12, and in consequence its appearance is a little belated, and the information provided about some associations rather behind the times. But the present is the twenty-ninth issue of a work of reference which has proved its utility to workers in science and literature; its welcome would be even greater if it could be published in October, when the academic and scientific sessions begin.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A COMET 1912*d*.—From *The Times* of February 26, we learn that a faint comet was discovered by Mr. B. Lowe, at Laura, South Australia, on December 31, 1912. According to the report by Mr. Dodwell, director of the Adelaide Observatory, the object was visible in a small telescope, and was seen to have a short tail; its position on December 30, at 5.30 p.m. (G.M.T.), was about 4° south of Spica, and it was travelling southwards so rapidly that the position on January 5 was about $\alpha = 14$h. 30m., $\delta = 29° 50'$ S. An approximate orbit gives February 3 as the time of perihelion passage, when the comet was probably some sixty million miles from the sun, and indicates that the least distance from the earth occurred about the time the object was discovered, and was about twenty-five million miles. Mr. Dodwell also states that Mr. Lowe anticipated Mr. Gale in the discovery of comet 1910*a*, but did not notify the fact until later.

AN INTERESTING OCCULTATION.—On March 13 an interesting occultation will be provided by the moon passing in front of the Pleiades. As new moon occurs on March 8, our satellite will, at the time of the occultation, present a fairly thin crescent, and the several stars of the group will disappear at various points on the dark limb, to reappear at the bright limb. The first bright star to disappear will be Electra (mag. = 3·8), which will enter near the southern horn at 10h. 1m. p.m. Then will follow Merope

(mag. = 4·3), hidden from 10h. 7m. to 11h. 2m.; Alcyone (η Tauri, mag. = 3·1), from 10h. 47m. to 11h. 25m.; Atlas (mag. = 3·8), from 11h. 20m. to 12h. 9m. (midnight); and Pleione (mag. = 5·2), from 11h. 26m. to 12h. 7m. Asterope, Taygeta, and Maia will not be occulted, and it will probably surprise many people to observe how much larger the Pleiades group apparently is than the moon; about one degree, or two lunar diameters, separate Atlas from Taygeta or Electra. Occultations of the Pleiades will also occur, in daylight in Great Britain, on July 28 and October 18.

PUBLICATIONS OF THE VIENNA OBSERVATORY.—We have received vols. xxi. and xxii. of the *Annalen der K.K. Universitäts-Sternwarte in Wien,* edited by Prof. Hepperger. The former contains the results secured with the 27-in. Grubb refractor during the period 1903–06, and deals with a great number of observations of planets, comets, and nebulæ. The second volume is divided into two parts, the first dealing with planet and comet observations made with the 6-in. Fraunhofer refractor by Dr. J. Holetschek during 1903–10, and the second, by Dr. J. Rheden, giving an account of the observing station, and the observations made, at Sonnwendstein, from November, 1909, to 1910. The Sonnwendstein station is at an altitude of 1523 m., and the daily notes concerning the atmospheric conditions and their influence on the observations are of special interest.

ASTRONOMICAL YEAR-BOOKS.—"The Observer's Handbook for 1913," published by the Royal Astronomical Society of Canada, is a very useful, though small, volume, which contains a great deal of information set out in a form most useful to the amateur astronomer. In addition to various ephemerides it gives the astronomical phenomena for each month, and a detailed summary of special stellar objects which are available for observation month by month. It also contains four very useful and clear star charts, covering the whole sky, and a brief account of "Recent Progress in Astronomy," written by Mr. W. E. Harper.

The *Annuario* of the National Observatory of Brazil contains the usual full complement of ephemerides and astronomical and physical tables. An interesting map is also included, showing the central lines of all the total eclipses of the sun visible in Brazil between the years 1912 and 2162, as prepared by Prof. D. Todd.

THE EUGENICS EDUCATION CONFERENCE.

THIS conference was organised by the Eugenics Education Society for the purpose of opening up discussion on the possibility and advisability of infusing the eugenic ideal into the minds of school children and on the best methods for so doing. More than 400 headmasters and headmistresses or their representatives assembled in the large hall of London University on March 1 to take part in the debate, and it is in some ways to be regretted that with so large and expert an audience the subject discussed should have been rather sexual hygiene than eugenics. The relation between the two subjects was so clearly and admirably pointed out by Major Darwin in his presidential address on the eugenic ideal, that it is difficult to understand why so many subsequent speakers should have appeared to regard them as identical.

The discussion at any rate had the merit of showing how much the minds of the more earnest educationists are exercised in the question of instruction in sexual hygiene. The objections to its introduction into schools fall into three classes. In the first place it is maintained that the growing mind should be kept free from thoughts on sexual matters; to which it may be answered that practical experience shows this to be impossible. In private schools, attended by boys of nine to fourteen years of age, such subjects are certainly discussed, and it cannot be supposed that the pupils of corresponding ages in public elementary schools, with their ampler experience of the seamy side of life, are behindhand in this respect.

Secondly, there are many who say that it is practically impossible to introduce the subject in a fitting manner. These were answered by Mr. Badley, headmaster of Bedales, the well-known coeducational school, and by Miss Bonwick, headmistress of the Enfield Road Primary School, who each described their own methods. Miss Bonwick's speech is worthy of special mention, as her eloquence and enthusiasm made a marked impression on the audience. Prof. J. Arthur Thomson also dealt with this aspect of the subject clearly and wisely.

Thirdly, it is said that instruction as to sex should be given by the parents, to which it may be answered that in most cases the parents are quite unfit to give it.

Major Darwin, speaking in the name of the Eugenics Education Society, did not attempt to teach the teachers on these matters, but urged that in all institutions where sex hygiene is taught it should be taught in connection with the eugenic ideal. His address, together with those of the headmaster of Eton, the Principal of Bedford College, Prof. J. Arthur Thomson, and Mr. Badley, and the reports of other speeches, will be published in the April number of *The Eugenics Review,* and have therefore scarcely been touched on here. E. H. J. S.

NAPIER TERCENTENARY CELEBRATION.

IN the year 1614 John Napier, Baron of Merchiston, published his "Mirifici Logarithmorum Canonis Descriptio," a small quarto volume, the influence of which upon the development of mathematics, especially as an instrument of calculation, cannot be overestimated. The council of the Royal Society of Edinburgh, mindful of the greatness of the boon conferred on science by Napier's invention, convened a committee representative of some twenty societies, corporations, and institutions to discuss the proposal to hold a celebration in memory of the event. The universities and colleges of Scotland, the Faculty of Actuaries, the Edinburgh Mathematical Society, the Institute of Bankers, and other like bodies, also the Royal Society of London and the Royal Astronomical Society, were represented by delegates to the first meeting of the committee, which was held in the Royal Society Rooms, 22 George Street, Edinburgh, on Saturday, February 22. Mr. J. R. Findlay, one of the representatives of the Edinburgh Merchant Company, was voted to the chair.

Dr. Knott (general secretary, Royal Society of Edinburgh) and Dr. A. E. Sprague (Faculty of Actuaries) were appointed honorary secretaries in connection with the celebration, and Mr. Adam Tait, Royal Bank of Scotland, was appointed honorary treasurer. With these as officials, an executive committee was nominated to carry into effect the following resolutions:—

That a congress be held in the summer of 1914, to be opened by a public reception and an address by an

eminent man on some aspect of Napier's life and work; that, in response to an invitation from the directors of Merchiston Castle School, a garden-party be held in the grounds of Merchiston Castle; that papers be read on methods of calculation and of mathematical teaching; that exhibits be made of all kinds of calculating machines, of logarithmic and other mathematical books which are necessary for calculation, and of objects of historic interest associated with the name of Napier; that eminent mathematicians be invited from foreign countries to take part in the celebration; that a memorial volume be published containing the more important of the addresses and communications; that, to meet preliminary expenses, a donation list be opened, to which societies and individuals may contribute; that those interested in the proposal be asked to become founder members, the subscription being 2; and that the ordinary subscription be kept as low as possible.

The executive committee was given powers to add to its number and to appoint subcommittees to take charge of the special departments of work indicated above, and of any other lines of development which might occur to them.

THE METHOD OF "SHOCK-EXCITATION" IN WIRELESS TELEGRAPHY.

IN *Die Naturwissenschaften* of January 24 there appears an excellent short descriptive article on the principles and the advantages of the "shock-excitation" method of generating electrical oscillations, written by Dr. G. Eichhorn. The method of shock-excitation is used in wireless telegraphy on the large scale by the Gesellschaft für drahtlose Telegraphie ("Telefunken" system), and was first properly investigated and explained by Max Wien. Its essence consists in using a very short-lived oscillatory discharge in a primary circuit, to excite oscillations in an antenna arranged as a secondary circuit, the life of the primary oscillation being, in the ideal arrangement, just so long as to admit of the transference from primary to secondary of the maximum fraction of the initial energy—that is, the energy stored on the condenser in the primary circuit just before the beginning of its discharge. The points especially discussed are the conditions governing, and the means of realising, this ideal arrangement.

Dr. Eichhorn starts with the fact that in a pair of coupled circuits the phenomenon known as "beating" takes place, and that in the time of a beat the oscillatory energy passes from the primary to the secondary and back again. The time of a beat depends on the closeness of the coupling, being shorter with closer coupling. But in the quenched spark method of exciting oscillations the stoppage of the primary oscillation is effected by cooling the spark—that is to say, by de-ionisation of the spark-gap—and the critical moment for the stoppage is the first occasion on which the whole energy passes from the primary to the secondary, namely the moment of the middle of the first beat in the secondary circuit. Thus the better the quenching the closer can the coupling be made. The author shows that the primary must be tuned to the secondary the more exactly, the less effective the quenching is. Among the advantages claimed for the method that of economy is placed first, and a comparison of published researches shows that this method of shock-excitation may have an efficiency of 75 per cent. as against the 25 per cent. of the ordinary spark or the 10 per cent. of the Poulsen arc method.

A SUPERANNUATION SCHEME FOR ENGLISH UNIVERSITY TEACHERS.

THE advisory committee on the distribution of Exchequer grants to universities and university colleges in England has issued its second report (Cd. 6617). In the first report it was recommended that a certain proportion of the grant of 149,000*l.* available for distribution among the English colleges should be reserved pending consideration of a superannuation scheme, and should be regarded as applicable to the institution of such a scheme and to other purposes.

Several conferences have been held between a subcommittee of the advisory committee and representatives of the universities and colleges concerned, existing schemes have been examined, the possibility of a federated scheme has been considered, and the present report gives the governing principles which the committee suggests should underlie each scheme.

I. *Scope.*—(*a*) The new scheme should come into force on October 1, 1913, when—

(1) It should be compulsory on all new entrants in receipt of a salary of not less than 300*l.* a year.

(2) All new entrants in receipt of less than 300*l.*, but not less than 200*l.* a year, should be entitled to join the scheme.

(3) Any new entrant in receipt of less than 200*l.*, but not less than 160*l.* a year, should, with the consent of the governing body, be allowed to join the scheme.

(4) Any member of the existing staff who satisfies the salary conditions under (1)-(3) above should, with the consent of the governing body, be allowed to join the new scheme under such provisions as to his interest (if any) in any existing scheme of superannuation as may be approved by the governing body.

(*b*) Provided always that no member of the staff should have a claim for inclusion in the scheme who does not, in the opinion of the governing body, devote his main time to his duties as a member of the teaching or administrative staff.

II. *Contributions.*—(*a*) The total contributions in all cases should be 10 per cent. of the salary, except that in the case of salaries above 1000*l.* a year no contributions should be made in respect of the excess above 1000*l.*

(*b*) The normal contributions should be 5 per cent. of salary by the beneficiary and 5 per cent. by the institution, but if the governing body desire, it should be able to increase its proportion of the total 10 per cent. and diminish correspondingly the proportion payable by the beneficiary.

(*c*) If a person is a member of the staff of two or more institutions both within the federated system, the combined salary should be taken into account and the institutions should contribute *pro rata.*

III. *Benefits.*—(*a*) The benefit should include an annuity on reaching the age at which the benefit matures, or, so far as the governing body thinks desirable in each case, an equivalent cash payment. The beneficiary should, however, have the option of choosing a form of provision which secures in addition benefit in the event of death.

(*b*) The age at which the policies mature should be fixed at sixty.

IV. *Means of Securing the Benefit.*—Every beneficiary should have the option of securing his benefit by means of an insurance policy. The governing body should have the power, however, if it thinks desirable, in individual cases, and if the beneficiary concurs, to accumulate the contributions by separate investment in trustee securities on behalf of the beneficiary. These separate investments may be in addition

to, or in substitution for, an insurance policy. Thus the various types of options would be as follows:—

(a) A deferred annuity or equivalent cash payment with a considerable benefit in the event of death while in service—to be obtained from insurance companies by means of "endowment assurance" policies of varied types.

(b) A deferred annuity or equivalent cash payment with return of accumulated contributions in the event of death while in service—to be obtained from insurance companies by means of a "sinking fund" policy (or, if necessary, in individual cases by separate investment as above).

(c) A deferred annuity without any return of premiums in the event of death while in service—to be obtained from insurance companies.

V. *Ownership of Benefit.*—(a) The governing body should hold the policy or other equivalent accrued benefit in trust for the beneficiary so long as he remains at the institution, and the beneficiary should execute some form of legal document which would enable the governing body so to do.

(b) On the transfer of a beneficiary from one institution to another within the federated system, the whole of the accrued benefit should be transferred to the second institution.

(c) In the event of a beneficiary leaving an institution before the retiring age, for any reason other than that indicated in (b) above, he should have the right to the whole of the accrued benefit, but the governing body should have the right to determine how the accrued benefit should be given.

The advisory committee states that universities and colleges would be prepared to inaugurate a superannuation system on the basis of the foregoing principles, but, as in most cases increased outlay will thereby be involved ultimately, it is unreasonable to expect them to adopt the proposals until they know the amount of the assistance they may expect to receive by way of grant. The committee therefore makes recommendations for a further distribution of the money held in reserve.

Grants are made to thirteen universities and colleges varying from 1000*l.* each in the case of the Universities of Liverpool and Manchester, to 300*l.* each in the case of Bedford College, London, London School of Economics, East London College, and Reading University College. The colleges at Nottingham and Southampton do not receive additional grants.

The additional grants now recommended, together with those announced in March, 1912, dispose of a yearly sum of 148,000*l.* out of the 149,000*l.* available. The committee recommends that the annual balance of 1000*l.*, together with the balance of 2550*l.* from previous Exchequer grants, should be held over to meet contingencies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Lord Mayor of Birmingham has opened a fund for the establishment of a memorial to the late Vice-Chancellor, Alderman C. G. Beale, whose services to the city were such as to demand a permanent monument to his name. It is proposed to devote the money subscribed to two objects, both of which would certainly have had the approval of the late Vice-Chancellor, viz. the endowment of a chair in the University (to be called the Beale chair), and the equipment of one of the rooms in the new Natural History Museum of the city with a collection of British birds and their nests in natural surroundings. Already promises to the amount of 9000*l.* have been received, including one donation of 5000*l.*, earmarked for the Beale chair, from that most generous friend of the University Sir Charles Holcroft.

CAMBRIDGE.—The General Board of Studies will proceed shortly to appoint a University lecturer in the philosophy of religion. The appointment is for three years from October 1, 1913. The annual stipend is 100*l.* Candidates are requested to send their applications to the Vice-Chancellor, with testimonials, if they think fit, on or before Friday, April 11.

Mr. A. Harker has been nominated to represent the University at the twelfth International Geological Congress to be held in Canada in August next.

OXFORD.—Sir William Mitchell Ramsay will deliver the Romanes lecture at the Sheldonian Theatre on Thursday, May 8, at 3 p.m. The subject of the lecture is "The Imperial Peace."

Mr. R. B. Bourdillon, lecturer in chemistry at Balliol College, has been elected to a fellowship in chemistry on the teaching staff of University College.

The degree of M.A. has been conferred by a decree of Convocation on Prof. W. H. Perkin, F.R.S., fellow of Magdalen College, the recently elected Waynflete professor of chemistry.

At the same Convocation, the statute altering the constitution of Congregation by abolishing the qualification of residence, and making other changes with the view of confining the membership to the "teaching and administrative elements in the University and the colleges," passed its final stage by 77 votes to 49.

In the Educational Supplement of *The Times* of March 4 an important letter appears from Prof. Poulton, F.R.S., pointing out that the extension of the scientific departments of the University was one of the principal objects had in view by the promoters of the original purchase for the University of the ground known as the Parks. The letter directs attention to a scheme which was devised some years ago, though not accepted by the University, in accordance with which a space of ten or eleven acres adjoining the museum at the south-west angle of the Parks would be definitely allocated to the purposes of the scientific departments at present existing or to be established in future. This would leave six-sevenths of the present open space untouched and unthreatened by building.

SHEFFIELD.—Dr. Sophia M. V. Witts has been appointed to the newly instituted post of lady tutor in anatomy.

MR. AUGUSTINE HENRY, reader in forestry, University of Cambridge, has been appointed to the professorship of forestry recently established in the Royal College of Science for Ireland.

DR. A. R. FORSYTH, F.R.S., formerly Sadlerian professor of pure mathematics in the University of Cambridge, has been appointed chief professor of mathematics at the Imperial College of Science and Technology, South Kensington.

As announced already, a course of four public lectures on the theory of the solid state, will be delivered at University College (University of London), by Prof. W. Nernst, director of the Institute of Physical Chemistry in the University of Berlin, at 6 p.m. to-day, March 6, and at 5 p.m. on March 7, 10, and 11. The chairman at the first lecture will be Sir William Ramsay, K.C.B.

AT the annual meeting of the court of governors of the Middlesex Hospital, on February 27, Prince Alexander of Teck, in moving the adoption of the report, announced an anonymous gift of about

10,000*l.* The object of the gift is to defray the cost of erecting a new pathological block and institute of hygiene. The scheme is one which the governors have been anxious to carry out for some time, as the present accommodation is wholly inadequate, but lack of funds has hitherto proved an insurmountable barrier to progress in this direction. The plans have been prepared, and it is hoped the work will be started almost immediately.

AT the meeting of the executive committee of the Carnegie Foundation for the Advancement of Teaching, held on February 11, it was announced that Mr. Andrew Carnegie had given an additional 250,000*l.* to the foundation. The gift is in the form of 4 per cent. bonds and the income is to be set aside for special investigation relative to the purposes of the original foundation of pensioning college professors. The money is to be devoted to the endowment of a division of educational inquiry and makes permanent provision for studies hitherto conducted by the foundation out of its general fund. It is the plan of the trustees to proceed with the new endowment to make other studies similar to those already published concerning medical education and in particular to study legal education in its relation to the supply of lawyers and the cost of legal process.

AN appeal on behalf of the British and Foreign Blind Association, 206 Great Portland Street, London, W., signed by four blind members of the executive council, including Mr. H. M. Taylor, F.R.S., is being circulated. One of the chief objects of the association is the maintenance of a printing press of works in embossed type; and properly to carry out this and other good works the council finds that extended premises are necessary. The sum of 10,000*l.* has been expended in carrying out part of the work entailed by the scheme for a new building, and the completion of the work, including adequate equipment, necessitates the raising of a further sum of 29,000*l.* The council is anxious that the invested funds of the association, producing an annual income of some 400*l.*, should not be touched. To maintain the work on an enlarged scale an increase of 1000*l.* in annual subscriptions is needed. Donations or subscriptions should be sent to the honorary treasurer, Mr. Douglas A. Howden, or to the secretary-general.

THE report of the committee of University College, London, for the year ending last month is full of interesting particulars of the manifold activities of the institution. The total number of students during the session 1911–12 was 1679, being an increase of 79 over that of the preceding session. Of these students 403 were engaged in post-graduate study and research. In the faculty of science there were 392 students, and in engineering 174. Of the 403 post-graduate and research students, 117 were women. There were 710 registered internal students of the University of London, compared with 678 in the previous year. We notice that the sums promised and paid, together with interest on deposit and rents, for the new chemical laboratories, amounted in July last to upwards of 38,000*l.* A tender for the erection of the fabric at a cost of 39,000*l.* has been accepted, and the work is being pushed forward. A sum of about 28,000*l.* will be required to complete the laboratories, and it is earnestly hoped that the necessary amount will be speedily forthcoming, so that the completion of the scheme and the opening of the laboratories may not be delayed.

THE erection of new chemical laboratories is not the only important step in progress for the development of the buildings of University College, London. The recently published report of the committee of the college gives, in addition to an account of the formal opening last December of the new Pharmacology Institute, particulars of the plans being adopted to provide a great hall for examinations and ceremonial occasions. The site of All Saints' Church, Gordon Square, the west wall of which adjoins the Carey Foster Laboratory, has been acquired at a cost of 5900*l.*, which, together with legal expenses, has been provided temporarily from current income, pending the provision of the necessary sum. The Ecclesiastical Commissioners have approved the scheme for the reconstruction of the existing church building. Under this scheme the old building will be so altered as to provide a hall capable of accommodating 1100 persons. The purchase of the site, together with the expenses of reconstruction and refitting, will involve an expenditure of 10,000*l.*; it is desirable to provide an organ, in addition to the ordinary fittings at a cost of 2000*l.*, making the total cost 12,000*l.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 27.—Sir Archibald Geikie, K.C.B., president, in the chair.—F. **Soddy**: The periodic law from the point of view of recent results in radio-activity.—C. F. **Jenkin** and D. R. **Pye**: The thermal properties of carbonic acid at low temperatures. The paper describes a series of experiments made in the engineering laboratory at Oxford, undertaken with the object of checking by direct measurements the accuracy of the accepted CO_2 entropy-temperature diagram, due to Mollier, and of extending the diagram to lower temperatures, *i.e.* from $-30°$ C. to $-50°$ C.—E. **Roberts**: Re-reductions of Dover tidal observations, 1883–4, &c.—Prof. F. **Keeble**, Dr. E. F. **Armstrong**, and W. N. **Jones**: The formation of anthocyan pigments in plants. Part iv., The chromogens. The results of the experiments described in this paper lend support to the hypothesis that the anthocyan pigments of plants are produced by the oxidation of colourless chromogens. Under certain conditions a coloured flower may be caused to reverse its pigment-forming process and to reduce the pigment which it contains to a colourless state. By again changing the conditions the pigment-forming mechanism may be made to resume activity and to give rise to pigments identical in colour with those of the normal intact flower. Whether the flower forms pigment or remains colourless depends on the degree of hydration of its tissues. If water be withdrawn from the tissues oxydase activity falls off, the activity of "reducing-bodies" becomes increased—actually or relatively—pigment formation is inhibited, and the pigment in existence already is reduced to chromogen. The flower becomes colourless. If water be supplied to the decolorised tissues, oxydase resumes its activity and chromogens are oxidised to pigments.—W. N. **Jones**: The formation of the anthocyan pigments of plants. Part v., The chromogens of white flowers. This paper, which deals with the biochemistry of the pigment-forming mechanism contained in white flowers, is a continuation of the work summarised in part. iv. of the present series of communications. As shown in the latter paper, the pigments of flowers may be reduced to the state of colourless chromogens and may be re-formed by artificial means from those chromogens. In the present paper it is shown that chromogens may be obtained from some white flowers and may be caused by similar treatment to give rise to pigments.—Mabel P. **FitzGerald**: The changes in the breathing and the blood at various high altitudes. The observations described in the paper were made during the summer of 1911 on persons residing in

towns, mining camps, &c., at various altitudes from 5000 to 14,000 ft. in the Colorado portion of the Rocky Mountains. The main conclusions reached are as follows:—(1) The volume of air breathed per unit mass of CO_2 produced by the body is always increased in persons acclimatised at high altitudes. The mean increase of breathing is such as to produce a fall of about 4·2 mm. (or roughly 10 per cent. of the normal for sea-level) in the partial pressure of CO_2 in the air normally present in the lung alveoli for every 100 mm. of fall in the barometric pressure. Both men and women show this fall, after allowance is made for the normal difference in the alveolar CO_2 pressure of men and women. (2) The percentage of hæmoglobin in the blood of acclimatised persons is likewise increased, the mean increase being about 10 per cent. of the normal at sea-level in men for every 100 mm. of diminution in the barometric pressure. Both men and women show this fall. (3) It may take some weeks for these changes to establish themselves fully in persons passing to a high altitude or to disappear in persons passing to sea-level.

Zoological Society, February 18.—Prof. E. A. Minchin, F.R.S., vice-president, in the chair.—H. B. **Preston**: Diagnoses of new species and varieties of agnathous mollusca from equatorial Africa. The author directed attention to the enormous field for conchological research awaiting the student of this very fruitful region, and stated that in many parts each range of hills appeared to have, to a certain extent, its own special molluscan fauna, often characterised by certain local and peculiar phases common not only to the species but also to the genera occurring in that particular locality.—W. A. **Lamborn**: Notes on the habits of certain reptiles in the Lagos district. An account was given of the habits of the lizard *Agama colonorum*, especially relating to courtship, polygamous practices, and combativeness, and of native superstitions in regard to chameleons. Observations were also recorded on a batch of eggs of a crocodile, probably *Crocodilus niloticus*, on their hatching, on the behaviour of the newly hatched young, and on the native beliefs as to the habits of the mother crocodile.—Dr. R. **Broom**: The Gorgonopsia, a suborder of the mammal-like reptiles. Descriptions of a new genus and two new species of Gorgonopsids, based on well-preserved skulls discovered by Mr. S. H. Haughton and the Rev. J. H. Whaits. The Gorgonopsia were re-established as a distinct suborder of the Therapsida, and a list of the characters distinguishing the Gorgonopsians from the Therocephalians was given.—Dr. R. **Broom**: The South African Rhynchocephaloid reptile, *Euparkeria capensis*. A detailed account of this species was given, and its affinities with allied forms discussed. The evidence at present seemed to show that Euparkeria was to be regarded as a member of an order of generalised Rhynchocephaloid reptiles, and might be taken as the type of a most important suborder of this group containing the ancestors of the Dinosaurs, the Pterodactyles, and the birds.—R. **Lydekker**: The heads of a male and female dwarf buffalo shot by Lieut. A. W. Hunt, R.N., in Southern Nigeria. The name *Bos caffer hunti* was suggested. This race agrees with the Gambian *B. c. planiceros* in that the adult bulls are darker than cows, but is of smaller size, with the orange band on the throat narrower. Mr. Lydekker also proposed the name *B. c. beddingtoni* for a mounted bull of a red dwarf buffalo from Ashanti, mainly on the ground that it is cut off from the red Congo *B. c. nanus* by the above-mentioned Nigerian race.—Dr. G. Stewardson **Brady**: Descriptions of two British Entomostraca apparently new to science. One was a Diaptomus, obtained abundantly in Loch Ness many years ago, but hitherto unnoticed; the other an Ostracod, of which one specimen only was found in brackish water in Sussex. The latter formed the type of a new genus, and possibly also a new family.

Institution of Mining and Metallurgy, February 20.—Mr. Edward Hooper, president, in the chair.—J. **Douglas**: Historical sketch of the Copper Queen Mines and Works, Arizona, U.S.A.—A. **Notman**: Geology of the Bisbee ore deposits.—C. **Legrand**: The power plant at Bisbee, Arizona; the power plant at Douglas, Arizona.—G. B. **Lee**: Reduction works at Douglas, Arizona. These five papers, dealing with different aspects of the famous Copper Queen property, are the amplification of a lecture delivered by Dr. Douglas before a special meeting of the institution in a previous session. The historical portion traces the development of the copper-producing industry in the Far West from its origin in about 1870 until the present date, incidentally showing the obligation under which mining is placed to the great railroad enterprises that have linked up the two sides of the continent. With regard to the geological surveys that have, more especially in recent years, supplemented the earlier empirical development work, Dr. Douglas points out that even in recent years the strictly exploratory work represents about one-fourth of the cost of the total mining operations, a proportion which it is hoped will be reduced in the future as the result of more accurate geological research. Mr. Notman's contribution to the quintet of papers shows that the system of geological survey has been conducted in a thorough manner, but that there are still unsolved problems with regard to many parts of the field, opening up possibilities of valuable discoveries in the sedimentary rocks of greater age and the intrusive igneous rock. The two papers dealing with the power installation at Bisbee and Douglas show that the consolidation of the various properties now comprised in the Copper Queen group has enabled a considerable improvement to be effected in this department. A feature of the reduction works is the attempt that has been made to deal with the problem of dust losses in the smoke from the converters and blast-furnaces.—R. **Davey**: Copper-smelting methods at Bogoslowsk, Perm, Russia. A special interest attaches to the works described in this paper, as they were among the earliest in the eastern hemisphere to adopt the Bessemerising of copper matte, the plant dating back to 1885. A modern plant is now in course of erection to supersede the somewhat out-of-date methods hitherto in vogue, which have accounted nevertheless for a considerable yearly production.

PARIS.

Academy of Sciences, February 24.—M. F. Guyon in the chair.—Paul **Appell**: Functional equation for the relative equilibrium of a homogeneous liquid in rotation under the Newtonian attraction of its parts.—H. Le **Chatelier** and Mlle. **Cavaignac**: The fusibility of the natural fatty bodies. From the study of the melting and solidifying points of two fats, vegetaline and stearin, it is shown that the phenomenon of change of state is strictly reversible. The exact temperature of transformation can be determined with an accuracy of 0·1° C., but the experiments require much time. There is no evidence of the existence of polymorphic bodies, the only peculiarity found being that the velocity of change of state is extremely slow.—Stuart **Menteath** and H. **Douvillé**: The Eocene deposits of Bos d'Arros.—Pierre **Duhem**: The stability of thermal equilibrium.—W. **Kilian** and Ch. **Pussenot**: A detailed analysis of the dislocations of the Eastern Briançonnais.—E. **Bompiani**: The configurations of Laplace.—Gustave **Sannia**: Some new properties of the char-

acteristics of partial linear equations of the first order in two variables.—T. de **Donder**: The theorem of independence of Hilbert.—L. **Crussard**: The propagation and alteration of waves of shock.—Alexandre **Sée**: A new principle of longitudinal stability of aëroplanes.—Albert **Turpain**: The recording of time signals and Hertzian telegrams with the aid of a Morse apparatus. A detailed description of two types of galvanometer used, in conjunction with a system of relays, in working recording apparatus.—V. **Crémieu**: The effects of flexion at the points of attachment of the wire of a torsion balance. A continuation of a previous paper on the same subject, with suggested applications to seismographs, dynamometers, and microbalances.—E. **Briner** and A. **Kuhne**: The transformation undergone by heated calcium carbide. When calcium carbide is heated in a closed vessel at 800° to 1000° C. the only transformation it undergoes is a decomposition into its elements. There is no evidence in support of the view that a subcarbide is formed.—E. **Fouard**: Differential tonometry of solutions and the theory of Arrhenius. The results with sugar are not in accord with the current theories of solution.—H. **Colin** and A. **Sénéchal**: The oxidation of complex cobalto-organic compounds. A study of the velocity of oxidation by air of an alkaline cobalto-glycerol solution.—Marc **Bridel**: The presence of gentiopicrin, gentianose, and saccharose in the fresh roots of *Gentiana punctata*.—R. **Dalimier**: The actions of the arseno-aromatic compounds (606 and neo-salvarsan) on the hæmoglobin of the blood. Dioxydiamido-arseno-benzene ("606") is without action of the hæmoglobin of the blood either *in vitro* or *in vivo*. Neo-salvarsan (sodium dioxydiamido-arseno-benzene sulphoxylate), on the contrary, has a marked action of the hæmoglobin. *In vitro* it causes hæmolysis and reduces oxyhæmoglobin; *in vivo* the reduction is not produced, and the hæmolysis rapidly vanishes. For these reasons there would appear to be reasons against the use of neo-salvarsan in certain cases.—V. **Grégoire**: The telophase and the prophase in somatic caryokinesis.—L. **Bounoure**: Observations on the post-embryonic evolution of *Dytiscus marginalis*.—A. Ch. **Hollande**: The figured bodies of the protoplasm of the œnocytes of insects.—P. **Chaussé**: The suspension in air of the virulent particles obtained by liquid pulverisation. A solution of a dyestuff (methyl violet) was sprayed into a room and experiments made on the time of suspension and transportability of the particles. Similar experiments have been made with tuberculous virus.—Albert **Berthelot**: Researches on *Proteus vulgaris* considered as a producer of indol.—Em. **Bourquelot** and J. **Coirre**: Some new data on the reversibility of the ferment action of emulsion.—J. **Stoklasa**, J. **Sebor**, and V. **Zdobnicky**: The synthesis of sugars by radio-active emanations. By the interaction of carbon dioxide and nascent hydrogen in the presence of radium emanations and potassium bicarbonate reducing sugars were obtained.

BOOKS RECEIVED.

Illustrated Catalogue of Physical Apparatus. Pp. 1032+xix. (London: F. E. Becker and Co.)

Three Years in the Libyan Desert. Travels, Discoveries, and Excavations of the Menas Expedition (Kaufmann Expedition). By J. C. E. Falls. Translated by E. Lee. Pp. xii+356+plates. (London: T. F. Unwin.) 15*s*. net.

Die Synchytrien: Studien zu einer Monographie der Gattung. By Dr. G. Tobler. Pp. ii+98+4 plates. (Jena: G. Fischer.) 5 marks.

Die Ontogenie der Primatenzähne: Versuch einer Lösung der Gebissprobleme. By Prof. L. Bolk. Pp. vi+122+2 plates. (Jena: G. Fischer.) 5 marks.

Chemistry of the Oil Industries. By J. E. Southcombe. Pp. xi+204. (London: Constable and Co., Ltd.) 7*s*. 6*d*. net.

A Synopsis of the Elementary Theory of Heat and Heat Engines. By J. Case. Pp. iii+65. (Cambridge: W. Heffer and Sons, Ltd.) 2*s*. 6*d*. net.

An Introduction to the Physics and Chemistry of Colloids. By E. Hatschek. Pp. ix+94. (London: J. and A. Churchill.) 2*s*. 6*d*. net.

Vicious Circles in Disease. By Dr. J. B. Hurry. Second and enlarged edition. Pp. xiv+280. (London: J. and A. Churchill.) 7*s*. 6*d*. net.

On Aristotle as a Biologist, with a Prooemion on Herbert Spencer. By Prof. D'Arcy W. Thompson. Pp. 31. (Oxford: Clarendon Press.) 1*s*. net.

The Physical and Political School Atlas. By J. G. Bartholomew. Pp. xvi+32. (Oxford University Press.) 1*s*. net.

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The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Twenty-ninth Annual Issue. Pp. vii+373. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*.

Union of South Africa. Mines Department. Annual Reports for 1911. Part iii., Geological Survey. Pp. 113+maps+plates. (Pretoria: Government Printing and Stationery Office.) 7*s*. 6*d*.

Life in Ancient India in the Age of the Mantras. By P. T. Srinivas Iyengar. Pp. x+140. (Madras: S Varadachari and Co.)

Anales del Museo Nacional de Historia Natural de Buenos Aires. Tomo xxiii. Pp. 415+plates. (Buenos Aires.)

Records of the Survey of India. Vol ii., 1910–11. Pp. iii+157+xi maps. (Calcutta: Superintendent Government Printing, India.) 6*s*.

The Science of Human Behaviour. Biological and Psychological Foundations. By Dr. M. Parmelee. Pp. xvii+443. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Ausführung qualitativer Analysen. By W. Biltz. Pp. xi+139. (Leipzig: Akademische Verlagsgesellschaft m.b.H.)

Geological Survey of Alabama. Iron Making in Alabama. By W. B. Phillips. Third edition. Pp. 254+xxxi plates. (Alabama: University.)

Pharmakognostischer Atlas. By Dr. L. Koch. Zweiter Teil der mikroskopischen Analyse der Drogenpulver. Zweiter Band. 2 Lief. (Leipzig: Gebrüder Borntraeger.) 3.50 marks.

Taschenbuch für Mathematiker und Physiker, 3 Jahrgang, 1913. Edited by F. Auerbach and R. Rothe. Pp. x+463. (Leipzig and Berlin: B. G. Teubner.) 6 marks.

Exercises in Gas Analysis. By Dr. H. Franzen. Translated by Dr. T. Callan. Pp. vii+120. (London: Blackie and Son, Ltd.) 2*s*. 6*d*. net.

Vorlesungen über die Theorie der Wärmestrahlung. By Dr. M. Planck. Zweite Auflage. Pp. xii+206. (Leipzig: J. A. Barth.) 7 marks.

Lehrbuch der Thermodynamik. By Drs. J. D. v. d. Waals and P. Kohnstamm. Zweiter Teil. Pp. xvi+646. (Leipzig: J. A. Barth.) 12 marks.

Year-Book of the Royal Society, 1913. Pp. iii+258. (London: Harrison and Sons.) 5*s*.

Qualitative Determination of Organic Compounds. By J. W. Shepherd. Pp. xvi+348. (London: W. B. Clive.) 6*s*. 6*d*.

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Practical Bird-keeping. Edited by J. L. Bonhote. Pp. xvi + 142 + plates. (London: West, Newman and Co.) 5s. net.

Das Relativitätsprinzip. By Dr. M. Laue. Zweite Auflage. Pp. xii + 272. (Braunschweig: F. Vieweg und Sohn.) 8 marks.

Reports of the Committee on Electrical Standards appointed by the British Association for the Advancement of Science. Reprinted by Permission of the Council. A Record of the History of "Absolute Units" and of Lord Kelvin's Work in Connection with These. Pp. xxiv + 783 + 10 plates. (Cambridge University Press.) 12s. 6d. net.

Psychology and Industrial Efficiency. By H. Münsterberg. Pp. viii + 321. (London: Constable and Co., Ltd.) 6s. net.

DIARY OF SOCIETIES.

THURSDAY, March 6.

Royal Society, at 4.30.—An Automatic Method for the Investigation of the Velocity of Transmission of Excitation in Mimosa: Prof. J. C. Bose.—The Evolution of the Cretaceous Asteroidea: W. K. Spencer.—A Preliminary Note on the Fossil Plants of the Mount Potts Beds, New Zealand, collected by Mr. D. G. Lillie, Biologist to Capt. Scott's Antarctic Expedition in the *Terra Nova* in 1911: Dr. E. A. Newell Arber.—(1) Trypanosomes found in the Blood of Wild Animals Living in the Sleeping Sickness Area, Nyasaland; (2) Trypanosome Diseases of Domestic Animals in Nyasaland—II. *Trypanosoma caprae* (Kleine); (3) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. I. The Human Strain: Surg.-Gen. Sir D. Bruce, F.R.S., Majors D. Harvey and A. E. Hamerton, and Lady Bruce.

Royal Institution, at 3.—Surface Energy: W. B. Hardy.

Institution of Electrical Engineers, at 8.—Recent Developments in the Street Lighting of Manchester: S. L. Pearce and H. A. Ratcliff.

Royal Society of Arts, at 4.30.—Indian Section—The City of Karachi: J. F. Brunton.

Linnean Society, at 8.—*Discussion*: The Development and Inheritance of Sexual Characters—Opener: G. Smith.

FRIDAY, March 7.

Royal Institution, at 9.—Photography of the Paths of Particles Ejected from Atoms: C. T. R. Wilson.

SATURDAY, March 8.

Royal Institution, at 3.—The Properties and Constitution of the Atom: Sir J. J. Thomson, O.M.

MONDAY, March 10.

Royal Society of Arts, at 8.—Coal Gas as a Fuel for Domestic Purposes: F. W. Goodenough.

Royal Geographical Society, at 8.30.

TUESDAY, March 11.

Royal Institution, at 3.—The Movements of the Stars: Our Greater System: Prof. H. H. Turner.

Mineralogical Society, at 5.30.—The Mineral Collection of Thomas Pennant (1726–1798): W. Campbell Smith.—The Minerals and Mineral Localities of Montgomeryshire: Arthur Russell.—A New Stereographic Protractor: Dr. G. F. Herbert Smith.—A (sixth) List of New Mineral Names: L. J. Spencer.

Illuminating Engineering Society, at 8.—The History of Gas-lighting in this Country: W. J. Liberty.

Institution of Civil Engineers, at 8.—Notes on City Passenger-Transportation in the United States: G. D. Snyder.

WEDNESDAY, March 12.

Royal Society of Arts, at 8.—The Use of White Lead in Painting: Noel Heaton.

Institute of Chemistry, at 8.—The Function and Scope of "The Chemist" in a Pharmaceutical Works: C. A. Hill.

Aeronautical Society, at 8.30.—Some Research: A. P. Thurston.

Royal Meteorological Society, at 7.30.—British Weather Forecasts: Past and Present: R. G. K. Lempfert.

THURSDAY, March 13.

Royal Society, at 4.30.—*Probable Papers*: A Simple Method of Finding the Approximate Period of Stable Systems: A. Mallock.—The Motion of Electrons in Gases: Prof. J. S. Townsend and H. T. Tizard.—The Self Inductance of Circular Coils of Rectangular Section: Prof. T. R. Lyle.—Ammonium Ferrous Sulphate and its Alkali-Metal Isomorphs: Dr. A. E. H. Tutton.—The Recombination of the Ions produced by Röntgen Rays in Gases and Vapours: H. Thirkill.—Optical Investigation of Solidified Gases. III. The Crystal-properties of Chlorine and Bromide: Dr. W. Wahl.

Royal Institution, at 3.—Surface Energy: W. B. Hardy.

Institution of Electrical Engineers, at 8.—Power Supply on the Rand: A. E. Hadley.

Concrete Institute, at 7.30.—Discussion of Reports of the Reinforced Concrete Practice Standing Committee on: (1) Cracks in Concrete; (2) Surface Treatment of Concrete.

Institution of Mining and Metallurgy, at 8.—Annual General Meeting.

Mathematical Society, at 8.—Some Cases of Tidal Motion of Rotating Sheets of Water: J. Proudman.—Indeterminate Equations of the Third and Fourth Degree: L. J. Mordell.

Society of Dyers and Colourists, at 8.—Stripping Agents for Garment Dyers: F. G. Newbury.—A Few Notes on Fur Dyeing: M. C. Lamb.

FRIDAY, March 14.

Royal Institution, at 9.—Great Advance in Crystallography: Dr. A. E. H. Tutton.

Institution of Mechanical Engineers, at 8.

Physical Society (University College, Gower Street), at 5.—Demonstra- [illegible] Working them, used as a High-frequency Oscillograph: Prof. J. A. Fleming.—The Stretching and Breaking of Sodium and Potassium: B. B. Baker.—The Latent Heat of Evaporation of Aqueous Salt Solutions: R. G. Lunnor.—Some Flame Spectra: Dr. E. N. da C. Andrade.

Royal Astronomical Society, at 5.

SATURDAY, March 15.

Royal Institution, at 3.—The Properties and Constitution of the Atom: Sir J. J. Thomson, O.M.

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By Wilhelm Ostwald. Pp. iv+544. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1912.) Price 9.60 marks.

It was at the Leeds meeting of the British Association in 1890 that three foreign chemists, van't Hoff, Arrhenius, and Ostwald, propounded and defended a new theory of solution which has since then been generally accepted. One of them, Wilhelm Ostwald, simultaneously imported another germ of thought, which for some years afterwards exercised the minds of Poynting, Lodge, Heaviside, and numerous other physicists. It was a development of the conception of the conservation of energy. It was the question as to whether energy, being indestructible, had an existence independent of matter, whether it retained its identity, and whether it could be followed up from point of point of space in its various transformations.

To Ostwald the idea came with the force of a revelation, and in the work before us he describes his "spiritual" experience with the most engaging candour. He confesses that the idea of the identity of energy and its commanding importance as the most fundamental of all realities has coloured and controlled his whole subsequent life.

This conception has undergone many vicissitudes. The Deutsche Naturforscher at Lübeck in 1895 appeared to dispose of it finally, and its discussion on that occasion was described as a "summary execution." Ten years afterwards Einstein put forward a plea for the identity of matter and energy, equating one gram with v^2 ergs, where v is the velocity of light in cm./sec. Planck's more recent hypothesis of the discrete or atomic structure of radiant energy lends unexpected support to Ostwald's original conception, and although it is difficult to see much advantage in substituting an elusive entity like energy for matter as a fundamental reality, it is quite possible that the identity of energy may play a considerable part in the future development of theoretical physics.

The present volume is a collection of essays strung (somewhat loosely sometimes) upon this central idea, propounded in the form of a precept which the author calls the "energetical imperative." This precept enjoins us never to waste energy, but to utilise it in its highest form. The four sections of (1) philosophy, (2) organisation and internationalism, (3) pacifism, (4) education, and (5) biography serve to group these essays with regard to the author's activity as a publicist.

In reading these brilliant essays, one is not surprised at the sobriquet of the "genial revolutionary" which their author earned among his friends in Leipzig. The energetical imperative is vigorously used to enforce economy and efficiency of organisation. It is propounded and proclaimed as the supreme guide in mundane matters, from the establishment of new universities to the binding of books. In organising, let us say, the science of chemistry, it is necessary to begin with the most commonplace details such as the spelling and division of words and the size of the printed page. Thus a "Weltformat" for printed books, based upon the centimetre, is suggested. It is designed in such a manner that every size can be obtained by the successive duplication of the smallest fundamental size, the sides of which are 1 cm. and $\sqrt{2}$ cm. respectively. No. 2 size is $\sqrt{2}$ by 2 cm., and so on. No. 9 size, 16 by 22·6 cm., is proposed as a universal size for scientific periodicals; No. 8 size, 11·3 by 16 cm., is a convenient pocket size; and No. 10, 22·6 by 32 cm., a good quarto.

Then we find a proposal to adopt one gram of pure gold as the basis of an international currency, and another to abolish the months of the calendar and count the days in numerical order. If, in addition, January 1 is made a supernumerary Sunday, with a similar interpolation at midsummer in leap years, the difficulty of determining days of the week is greatly reduced. The reading of numbers in thousands, hundreds, and the other powers of ten is to be abandoned, and numbers are to be read by a simple succession of figures, as is already the practice in quoting telephone and motor numbers. This reform applies, of course, with greater force in France or Germany than in England.

Then follows, very properly, the question of an international language. Ostwald is an enthusiastic supporter of the principle of an artificial international language, and defends it with conspicuous force and ability. Dr. Zamenhof's "Esperanto" was, by common consent, the finest and most successful solution of this problem hitherto proposed, and one naturally would have expected a born organiser like Ostwald to make the most of it. But his action in supporting Couturat's improved Esperanto ("Ido") was a very serious blow to the cause of Esperanto and of any artificial world-language. No doubt the abolition of the accented consonants was intended to facilitate the work of printing, but no such consideration justified the abandoning of the accusative case which gives Zamenhof's "lingvo" its marvellous flexibility.

If either of the rivals could thoroughly vanquish the other, or if they could settle their few differences, all would be well, but time alone will show whether Ostwald was in this instance a friend or foe of progress.

The author's proposal to divide words at any letter instead of by syllables would scarcely get rid of the difficulty of spacing out the line. Incidentally, one is led to hope that such blemishes as the substitution of "Zukunft" for "Folgezeit" (p. 484, line 4) and the adjective "vielfachen" for the corresponding adverb (p. 384, penultimate line) are accidental slips rather than premature reforms.

The distinguished founder and editor of the *Zeitschrift für physikalische Chemie* is at his best in discussing university problems, whether in connection with his biographical notes on Curie, van't Hoff, Abbe, and Ramsay (the latter was originally written for NATURE), or with the proposed foundation of new universities at Hamburg and Frankfort. He maintains that the unit of the future university must not be the faculty, but the laboratory, the institute, or the clinic. Teaching must be by work rather than lecture, and the work must be under the personal direction of a capable and enthusiastic chief in close touch with theoretical advances and practical problems.

The process of reasoning by which the irreversibility of all actual transformations of energy is made a fundamental ethical principle is one of daring originality. If, says Dr. Ostwald, occurrences were completely reversible (like ideal mechanical processes), then any mistake or wrong action could be completely annulled by reversing it. In fact, the whole world-history would read just as consistently backwards as forwards. What gives purpose and value and choice to life is the inevitable dissipation of energy. This must be directed into the most fruitful channels and put to the best use before it is lost in space. Peace is more fruitful and less wasteful than war, hence peace is good and war is bad. This is probably the first occasion on which a general physical law has been made the foundation of a system of ethics.

E. E. FOURNIER D'ALBE.

THE PRESENT POSITION OF RADIO-ACTIVITY.

Radio-active Substances and their Radiations. By Prof. E. Rutherford, F.R.S. Pp. vii+699. (Cambridge University Press, 1913.) Price 15*s*. net.

MUCH water has flowed under the bridge since 1906, when the second edition of Prof. Rutherford's "Radio-activity" was reviewed in NATURE by the present writer. Though its title has been changed, the work is not essentially different in plan from its predecessor. The fundamental aspect of the subject has not changed, but the pioneer investigations have for the most part been supplemented, and in a sense superseded, by subsequent work traversing the same ground, and the author has found it impossible to incorporate the newer work satisfactorily without entirely rewriting the book.

A pioneer has to encounter all the uncertainties of a voyage into the unknown. A vast expanse often lies before him. He has great difficulty in reaching the unknown country, and cannot survey it in the leisurely and methodical manner which is afterwards attainable. His first hurried impressions must often be erroneous. It is no easy matter to hold the due balance between the credit which properly belongs to him and that due to the successors who tread in the path which he has made. The skilful way in which this has been accomplished is a feature of the present work.

The process of gleaning after the original rich harvest is as yet far from complete. It is an open secret that Prof. Rutherford and his colleagues are now engaged on a revision of their fundamental determination of the properties of the α particles. We may confidently expect that the charge, the electrochemical equivalent, the velocity of expulsion, and the number of α particles emitted by radium will soon be established within a fraction of 1 per cent. It is scarcely to be hoped, however, that these researches will be so immediately fruitful as were the less accurate determinations which they will supersede.

The mass of detailed knowledge which Prof. Rutherford is now able to record may suggest that the wonderfully productive vein opened by Becquerel's discovery of radio-activity is approaching exhaustion. It may be that this view is not without foundation. The number of radio-active substances now known is no fewer than thirty-four, as against twenty recorded in 1906. It scarcely seems likely that the next six years will see an equal addition to the number, though prophecy on such subjects is notoriously rash.

In this connection it may be remarked that progress has not for the last few years altogether followed the lines that might have been anticipated. Some of the more obvious problems have been little pursued, such as the isolation of pure actinium and ionium and the determination of their atomic weights. The position of actinium in the disintegration series is still a mystery. We are still unable to state definitely whether atomic transformation ever occurs without the emission of any ionising radiation, though the steadily diminishing proportion of products regarded as "rayless" suggests an answer in the negative.

Finally, we know little more than before of the nature of the final products of radio-active transformations. In the case of radium, we have, indeed, strong indirect evidence that lead is the product, but direct evidence is still wanting. The recent investigations of Prof. Rutherford's school on "lateral disintegration," *i.e.* the formation of collateral branches of descent, make it not improbable that more than one final product of thorium exists. It may be hoped that now that powerful mesothorium preparations are produced commercially, a direct chemical investigation of these final products may eventually prove feasible. Each such final product identified may be expected to form a link connecting up common elements with the scheme of radio-active evolution. The early hopes of bringing these elements into the scheme have been disappointed. The β radiation of potassium and rubidium remain isolated and perplexing facts. It may be that the studies now so eagerly pursued on the *rôle* of β rays in the more rapid changes associated with the radium series will afford a clue.

The principal focus of interest at the present time is indeed in connection with the β and γ rays. The discovery of v. Baeyer, Hahn, and Meitner that the β rays from certain radio-active bodies can, by improved technique, be resolved into a line spectrum by the magnet has given the lead which was needed, and now we begin to see order and definiteness where all appeared before to be hopelessly involved.

In this subject, as in all others which have arrived at any maturity, the labour of keeping abreast of the literature becomes increasingly heavy, and the value of a complete and authoritative treatise up to date proportionately great. Even more gratitude will be felt to the author by workers in this field for the present work than for its predecessors. R. J. STRUTT.

MAP PROJECTIONS.

Map Projections. By Arthur R. Hinks. Pp. xii + 126. (Cambridge: University Press, 1912.) Price 5*s*. net.

NOTWITHSTANDING the large amount of surveying which has been done in this country and throughout the Empire, there are few works in English which treat of the various ways in which portions of the earth's surface may be most conveniently and correctly represented on the plane surface of a map. The subject has been treated partially by several eminent mathematicians, and valuable summaries occur in some encyclopædias, but we do not in this country possess any works such as those by Germain, Tissot, Hammer, and others. There are also many works of a less advanced type which are available to Continental geographers, but this class, too, is very insufficiently represented here. We therefore welcome the appearance of the present volume, in which the subject is treated clearly and in a manner which makes but small demand upon the mathematical training of the geographer, while at the same time the important points in any projection, suitability for special purposes, and facility of construction are given especial prominence.

After indicating the inevitable limitations of all projections, in representing length, area, and shape of any portion of the earth's surface, the author reviews the principal systems, and here the question of nomenclature has to be faced. There is as yet no general agreement in this matter, and the same projections are differently named by different writers, and in different counties. In the present work it is laid down that the first name of a title should describe the method of construction, a second name should indicate its principal quality, while the author's or introducer's name may be added in the case of projections which are specially associated with any individual. But even this arrangement cannot as yet be conveniently used in all cases, and several well-known projections are referred to by their usual names.

This difficulty of a suitable classification certainly increases the difficulties of the beginner, so that a tabular statement of the principal projections in this part of the book would be a useful addition. Conical, cylindrical and zenithal, as well as certain conventional projections, are well described and clearly explained, their special advantages and points of weakness being indicated. A chapter on the projections in actual use is an instructive addition, especially as at the present time there is much more activity in selecting the most suitable projections, both for wall-maps and for atlas maps, than was formerly the case.

The chapter on the simple mathematics of projections treats of the theory of each particular case, and discusses the errors which may arise in its use under different conditions. Several actual examples are worked out, so as to show the procedure in a particular case. The present volume will be of great use to all geographers, and should pave the way for a more serious study of cartography on scientific lines than yet generally obtains. Great care and labour are expended on the measurement of various regions in order to produce trustworthy surveys, and the utilisation of the results should be based on sound cartographical principles, and in such work this book will be a valuable assistance.

H. G. L.

OUR BOOKSHELF.

Miners' Nystagmus: its Causes and Prevention. By Dr. T. Lister Llewellyn. With a preface by Prof. J. S. Haldane, F.R.S., and a legal appendix by Douglas Knocker. Pp. xix+158+plates. (London: *The Colliery Guardian* Co., Ltd., 1912.)

MINERS' nystagmus is a disease which incapacitates a large number of coalminers, and is estimated by Dr. Lister Llewellyn to cost the country 100,000*l*. a year. It is characterised by rapid involuntary movements of the eyes, associated with defect of vision, photophobia, and night-blindness. Many theories have been brought forward to account for the disease. Of these the myopathic theory has been most supported in England, chiefly owing to the writings of the late Mr. Simeon Snell, of Sheffield. The work is carried on in constrained positions, often necessitating prolonged exercise of the extra-ocular muscles in an abnormal manner. It is now generally admitted that undue weight was attached to this factor, and attention has been specially directed to the view that the real cause is the poor illumination, a suggestion first made by Romiée, who, however, thought that excessive accommodation was an essential concomitant.

Dr. Llewellyn, as a former medical officer to a South Wales coal and iron company and as Tyndall Research Mining Student of the Royal Society, has had excellent opportunities for investigating the disease. He has used his opportunities to the full, and his work is a model of what such a research should be. He has shown conclusively that miners' nystagmus is practically limited to coal mines in which safety lamps are used, those in which naked candles are employed being exempt except for cases which have been transferred from safety-lamp mines. He has made exhaustive inquiries into the conditions of work and the illumination at the coal face. The estimations of illumination appear to have been made with great care and accuracy, and the same may be said of the clinical investigations. In addition to his own researches, his book contains an admirable *résumé* of the opinions and work of previous writers on the subject. The criticisms are judicial in tone, and the exposition of his own views allows the facts and arguments to carry conviction without undue stress. The work is of interest not only to those specially associated with the mining industry, but also to the physician and physiologist. We consider that Dr. Llewellyn has accomplished a difficult task with distinguished success.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. xii.: Catalogue of the Noctuidæ in the Collection of the British Museum. By Sir George F. Hampson, Bart. Pp. xiii+626. (London: Printed by Order of the Trustees, 1913.) Price 17*s*. 6*d*.

THE subject of this volume of the "Catalogue of Moths" is the classification of part of the Noctuid subfamily Catocalinæ. The remaining portion of the subfamily, together with the small subfamilies Mominæ and Phytomatrinæ, will appear in vol. xiii. The Catocalinæ are represented in the present volume by sixty-three genera and 643 species, and are characterised as follows:—Vein 5 of the hind wing is developed fully and arises close to the lower angle of the cell; the eyes are smooth and not overhung by "cilia"; the mid tibiæ are always spined, and the fore and hind tibiæ may also be armed similarly. The subfamily is a modification of the Quadrifid section of the Noctuidæ; it is distributed fairly evenly in the temperate and tropical zones, but has few arctic or alpine forms.

Volcanoes: Their Structure and Significance. By T. G. Bonney. Third edition. Pp. 379. (London: John Murray, 1912.) Price 6*s*. net.

PROF. BONNEY'S well-known volume was reviewed at length in the issue of NATURE for May 11, 1899 (vol. lx., p. 27), at the time of its first publication. Many minor alterations have been made in the present edition, and several paragraphs inserted dealing with volcanic eruptions which have take place recently. The chapter on the theories of volcanoes has been considerably modified so as to incorporate the results of research accomplished during the last fourteen years. Some new illustrations also have been added.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Radio-elements and the Periodic Law.

AT a meeting of the Royal Society on February 27th, Mr. F. Soddy made a verbal communication which was published under the above title in the *Chemical News* of the following day. The importance of the conclusions which are drawn justifies an examination of the evidence on which they rest. I do not approach the question unsympathetically, and I am quite willing to take some risks, but, when asked to accept a theory, I like to draw a distinction between a guess, a reasonable generalisation, and a well-established conclusion. If Mr. Soddy only wishes to put forward a theory which is not inconsistent with the facts so far as they are known at present, I have nothing to say, but if he claims anything approaching to experimental proof, some critical comment may be forgiven.

Mr. Soddy believes in the existence of a number of bodies which differ in molecular weight but "are non-separable by any known process"; these are also supposed to have identical spectra. Among "known processes" I count gravitation, diffusion, and mechanical processes, such as separation by centrifugal forces, among which diffusion, perhaps, is the only available one. Is there any reason to suppose that molecules which, ex hypothesi, differ in mass, cannot be separated by diffusion? Some of the bodies concerned are gaseous, others no doubt are volatisable, and though diffusion may not act very effectively, owing to the close approximation of the densities, the presumption is that the molecules, having different masses, travel with different speeds, and that it is

therefore incorrect to call two gases with different densities "non-separable by any known process."

Electrical and magnetic forces are also agents which can be applied to distinguish between molecules having different masses. Such forces should be considered before any sweeping assertions are made.

It is possible that Mr. Soddy wishes his statement to be limited to the ordinary chemical processes, and as he is trying to prove a negative, it is perhaps unfair to be too critical, but one cannot help remembering the time when neodym and praesodym were "non-separable," and reflecting how many substances might not be separated at the present moment if their optical properties had not given us a clue. No doubt radio-active tests are severe, and the chemical properties of the bodies in question are probably more nearly equal than those of the older chemistry, but there is a vast interval between "very similar" and "identical."

Incidentally, we may reflect that these bodies which are believed to be "non-separable" actually separate themselves of their own free accord in the natural course of their subsequent history, but this may only prove the perversity of nature.

According to Mr. Soddy's theory, the non-separable bodies have identical spectra. This is the vital issue, which, if made good by experiment, will help us to overlook many weaknesses in the argument. The evidence here rests entirely on one experimental fact. It was shown by Russell and Rossi, and also by Exner and Haschek, that a mixture of ionium and thorium does not show in the electric arc lines which can be assigned to ionium, the spectrum of the mixture being identical with that of pure thorium. Assuming that ionium is the only intermediate product between thorium-II. and radium, the life of ionium is 100,000 years, and the ionium-thorium preparation of Russell and Rossi must have contained about 16 per cent. of ionium. But these authors also point out that if the length of life is reduced to 12,000 years, the preparation would only contain 2 per cent., and the absence of ionium lines would be accounted for. At present the radio-active evidence seems in favour of the longer period, and the absence of ionium lines wants explaining; nevertheless, it seems to me to be going ahead too quickly to make a sweeping assertion that not only is the spectrum of ionium identical with that of thorium, but that the same holds in all similar cases, for the accumulated evidence of the spectra of known bodies has all been in the direction of indicating that optical properties of absorption and radiation discriminate in the most decisive manner between bodies which are otherwise similar in chemical properties.

Granting now for the sake of argument that the bodies in question have spectra which cannot be distinguished from each other, it remains to examine the alternative that the bodies are actually identical. It is said that they have different molecular weights, because one has been formed from the other by an expulsion of one α and two β particles. This argument is not necessarily conclusive, as a mass equal to that expelled may have been picked up again in the process. It may be urged that the subsequent history of these bodies shows that they are essentially different. Though a strong argument, this is not quite the last word, because, granting for a moment the temporary identity of two systems, the particular instability which determines their future may depend on their past.

Taking all arguments into consideration, we are left with an interesting theory consistent with our present knowledge but supported by very little real evidence. It may be presumptuous for one who can only claim to be an amateur in modern physics to express an opinion, but having in a previous generation taken part in establishing the fact that the same element can have different spectra according to its molecular constitution, one cannot, without good cause, accept the belief that different elements can have the same spectrum. Mr. Soddy's case would be much strengthened if he could adduce positive instead of merely negative evidence, and this might be supplied if the bodies grouped together with thallium lines could be shown to give the thallium spectrum, assuming thallium not to be present in the raw material.

ARTHUR SCHUSTER.

Manchester, March 7.

Atmospheric Electrification during South African Dust Storms.

THIS short note on the variation in the atmospheric electrical charge due to the presence of dust is not intended to be exhaustive, but merely to direct attention to a factor which has a very great influence in modifying the positive potential gradient existing in the atmosphere during fine weather. Very few observations as to the causes of the variations have been recorded, but Prof. Michie Smith seems to have observed (*Phil. Mag.*, vol. xx., p. 456) something of the same kind during dust storms in India. He notes that "the negative electrification was strongest during gusts of dust-laden air," and, further, "the potential would often run up so rapidly that it was impossible to measure it accurately, whilst during lulls it would often fall almost to zero."

I was, however, unaware of any work having been done in this direction until the present year, though I have been making a study of the variations in the potential gradient over the high veld in South Africa, and have published several short papers on the subject.[1] The general result has been to show that very extraordinary variations are caused by the presence of dust in the atmosphere, whether due to the natural dust-storms or to any artificial means, such as the clouds of dust raised from the mine refuse heaps formed during the working of the cyanide process. At all the places where observations have been taken the dust is either sand or is of siliceous character, and invariably has the effect of lowering the positive potential gradient, and if present in sufficient quantity, to reverse it and give a very high negative gradient.[1]

During the past six months systematic observations have been taken at Bloemfontein with a Bendorf recording electrometer, furnished with a radium-coated plate to act as collector. (The apparatus was obtained by aid of a grant from the Royal Society of South Africa.) The normal potential gradient in South Africa is, of course, positive, but varies considerably with the elevation. The diurnal range is also considerable under fine weather conditions, and during stormy weather very great deviations are shown if rain is falling or dust is blowing. It may be noted here that during the past eighteen months, when very little rain has fallen, the charge brought down by the rain has been invariably negative. A study of the records made by the electrometer shows that three types have to be considered, viz. :—(1) The ordinary fine weather record; (2) record taken on a day when some dust is blowing; (3) record taken on a very dusty day.

In the first case, the positive gradient rises to a maximum at about 7 to 8 a.m., falls to a minimum at midday, remains fairly uniform over a period of several hours, and then rises to another maximum. The slope of the curve is steeper for this second maximum than for the first one. Fig. 1 shows such a curve which was taken in July, from midnight to midnight. The horizontal line shows zero potential,

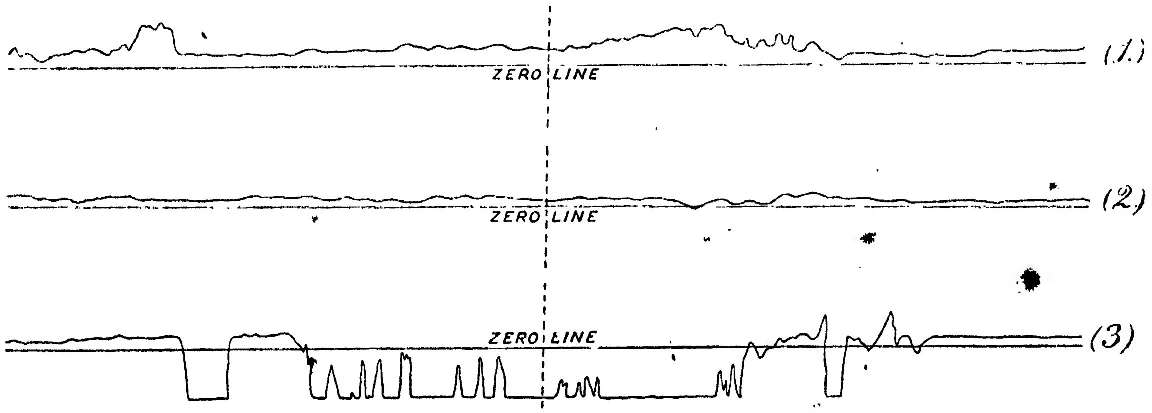
[1] *South African Journal of Science*; Proc. Roy. Soc. South Africa.

and distances measured above give positive values, and those below negative. The extreme range of the scale is equivalent to a gradient of 380 volts per metre.

Fig. 2 gives the record for a dust-storm which lasted the greater part of the day. In this figure it may be seen that the positive value never goes beyond 70 volts per metre, and on one occasion even becomes slightly negative.

Fig. 3 records a severe dust-storm which lasted from 4 a.m. until 8 p.m. The maximum value of the negative gradient cannot be inferred from the curve because the electrometer needle was deflected as far as it could go, and the horizontal portions of the curve indicate that the potential gradient was higher than the maximum which could be recorded. It will be shown presently that the gradient may reach the value of 5000 to 10,000 volts per metre when the dust is blowing thickly.

The writer has shown (*Phil. Mag.*, May, 1912) that during a dust-storm the charge upon the dust (if siliceous) is positive, while that upon the air at the same time is negative, and he was led from this to devise an electrical machine by means of which charges of both positive and negative electricity might be obtained during a dust-storm. The essential parts are:—(1) A small insulated disc coated with radium attached to a wooden rod about two metres in height; (2) a large hollow vessel with a fine wire gauze bottom; and (3) a pair of insulated spheres to serve as dischargers. The hollow vessel generally used was a five-gallon petrol tin supported upon an insulated rod at a distance of about 20 cm. above the ground, and directed with the open end towards the onrushing dust. Much of this dust is carried through, but a considerable portion is retained, and any charge it may possess is given up to the vessel. *This charge was invariably positive.*



(1) Normal fine weather record (2) a mild dust-storm; (3) a severe dust-storm.

The radium-coated conductor, however, took the negative potential of the current of air blowing past it, so that the two balls acquired opposite charges, and a torrent of sparks as continuous as that furnished by an induction coil passed between them. On some occasions the sparks reached a length of 1·5 cm., showing that the potential difference between the conductors must have been at least 40,000 volts when the apparatus was set up on the open veld.

An ordinary vacuum tube having a radium-tipped wire attached to an electrode, the other electrode being earthed, will light up brilliantly during the passage of a dust-storm. A brush discharge is seen to proceed from the electrode and the shape of the brush makes it quite clear that positive electricity is escaping from the earth into the atmosphere.

W. A. DOUGLAS RUDGE.

Induced Cell-reproduction in the Protozoa.

IN the interesting letter by Mr. A. H. Drew, under the above heading, in NATURE, February 20, it is suggested in the last paragraph that certain substances called auxetics which caused the development of spores in the case of new species of Polytoma, may be necessary for cell-reproduction under natural conditions in ponds, &c., where such substances would probably occur owing to the putrefaction of organic matter.

In the course of an investigation which I have recently carried out on the process of excystation in the ciliated infusorian, *Colpoda cucullus*, from its resting cysts, I have found that this organism can emerge from its cysts when the latter are incubated in 1 per cent. hay infusion (alkaline or acid in reaction) and in pure distilled water—media quite free from auxetics. The real agent which is instrumental in causing excystation is an enzyme which digests the endocyst, and thus allows the organism to swim out into the surrounding medium. As is well known, *Colpoda cucullus* is an organism of wide distribution and of common occurrence in ponds and in infusions of hay, &c. It can frequently be found among rotting grass and decaying vegetation; situations in which the products of organic decomposition and bacterial putrefaction would be plentiful, yet the cysts of this organism can be caused to rupture and yield their contents in active condition when incubated in pure water.

I would therefore suggest that it is unsafe to infer that because auxetics may serve to induce cell-reproduction in certain cases, they may be necessary in all.

The winter spores of Polytoma and the resting (dauer) cysts of Colpoda are not perhaps quite comparable, but I may point out that Colpoda most frequently encysts in the condition of the resting cyst, and that therefore if auxetics are necessary at all they ought to be required for excystation from this condition.

An account of my investigations on this subject will shortly be published. T. GOODEY.

Rothamsted Experimental Station, Harpenden, Herts, March 4.

The Spectra of Neon, Hydrogen, and Helium.

IN a letter published in NATURE of March 6, Prof. Fowler pointed out that a series of "parallelisms" that we gave of lines in the spectra of neon and hydrogen were probably coincidences, and could not be taken as evidence of identity. We are sorry that we did not make our meaning plainer, in our letter in NATURE for February 27, for we did not mean that the lines we compared in the two spectra were

identical. The numbers we used were by Watson, and both spectra were measured from plates produced by the same instrument, and, of course, measured by the same person; thus experimental error was eliminated so far as possible. We were, however, in hope that possibly some similarity in atomic complexity might be argued from this "parallelism." But on talking the matter over with Prof. Fowler, whose knowledge of the subject is far greater than ours, we see that the evidence is not sufficient to justify any such assumption of similarity in the atomic complexity of these two elements, and we must therefore with regret abandon the idea.

J. NORMAN COLLIE.
HUBERT S. PATTERSON.

Mountain Stream Tadpoles in Natal.

SOME readers of NATURE will be interested to learn that tadpoles with large suctorial oral discs, enabling their possessors to adhere firmly to the rocks and boulders of mountain streams, have recently been discovered at Krantzkloop, in Natal, at an elevation of about 1500 to 1600 ft. They were found by the Rev. Fr. P. Boneberg, of Mariannhill, who kept them alive for some time, and observed their peculiar leechlike habit of sticking to one's fingers or to the sides of the vessel in which they were contained. Similar tadpoles have long been known from mountain streams in Borneo and other parts of the East, but so far as I can ascertain have not previously been recorded from Africa. However, the Natal tadpole belongs to the family Cystignathidæ (genus Heleophryne), whereas those of the Oriental region belong to the family Ranidæ, so that the adaptations are no doubt quite independently evolved. A description of this tadpole will be given in the next issue of the Annals of the Natal Museum.

JOHN HEWITT.

Albany Museum, Grahamstown, South Africa, February 1.

[IN his recently published account of the Batrachia of the Abor expedition, Dr. Nelson Annandale directs attention to some of the tadpoles (from Himalayan streams) which adhere to stones at the bottom or sides, and even in the vicinity of waterfalls. The majority adhere by their lips, which may be monstrously developed. In some other species a sucker, quite separate from the lips, and not homologous with the sucker that many young Batrachian larvæ possess, is found on the ventral surface, doubtless for the same purpose. It is interesting to note that some fishes have similar adaptations for adhesion.—ED. NATURE.]

INTERNATIONAL TIME AND WEATHER RADIO-TELEGRAPHIC SIGNALS.

IT is to the French Government that the world is indebted for the institution of an international conference on the radio-telegraphic distribution of time and weather signals. So long ago as 1908 the Bureau des Longitudes suggested a series of hourly signals from the Eiffel Tower for the determination of longitudes, and this service was brought into active operation in 1910. The great success which the service met with called for a more universal use of it, and to this end the French Government invited a certain number of foreign Governments to send delegates who had studied the problem of radio-telegraphy from the point of view of time and the determination of longitudes.

In October of last year such a conference was assembled, and programmes were formulated and resolutions passed with the object of preparing the way for the distribution of time and weather signals at stated hours from numerous selected stations suitably situated over the globe.

The outcome of this, the first international conference convened for this purpose, was a series of very important resolutions, but reference will only be made here to those that deal with the international time and weather signals. It may be of interest briefly to describe in the first instance samples of two signals that are being daily distributed at the present time, in order that the reader may compare them with the full international system which will be brought into operation on July 1 next.

Our purpose will be served if those sent out from the Eiffel Tower, Paris, and from Norddeich-Wilhelmshaven be alone considered, as these will show the different procedures adopted. To take the French signals first as recorded by a receiver in London. From this station morning and evening signals are transmitted, and at each transmission three separate "minute" signals are sent. Thus in the morning the observer can hear the tap from the pendulum clock in Paris at 10h. 45m. 0s., 10h. 47m. 0s., and 10h. 49m. 0s., and in the evening at 23h. 45m. 0s., 23h. 47m. 0s., and 23h. 49m. 0s., the clock indicating Greenwich mean time. In order to warn those who intend to receive the signals wherever they may be, a certain procedure is adopted which is the same for both morning and evening transmissions. This procedure is as follows:—

Let us suppose that we wish to correct our watch and therefore require to hear the morning signals. At about 10h. 40m. one sits by the receiving apparatus with the telephone fixed on the head, the coils set for the wave-length in use (about 2000 metres) and the detector adjusted, and waits for the preliminary signals. It may be mentioned here that the noise heard is of a powerful medium note, and the operator transmits the individual signals quite slowly so that they are easy to decipher.

The first sounds to be heard are the signal ta-te-ta-te-ta (—·—·— repeated three times, which is a "call" signal in Morse preliminary to every transmission. Then follows —···—, which means (=), a signal to separate the "call" from that which follows. The operator transmitting then sends out the following in Morse:—

·——· ·— ·—· ·· ··· ——— —··· ··· · ·—· ···— ·—
P A R I S O b s e r v a

— ——— ·· ·—· ·
t o i r e

—···—
(double dash)

··· ·· ——· —· ·— ··— —··— ···· ——— ·—· ·— ··
s i g n a u x h o r a i

·—· · ···
r e s

·—··· ·—··· ·—··· ·—···

The last four signals indicate "wait," repeated four times.

The foregoing announcement is the preamble preliminary to the time signals.

At 10h. 44m. os. a series of longs or – – – –, &c., are transmitted, ceasing at 10h. 44m. 55s.; then there is silence for some seconds, and *exactly* at 10h. 45m. os. a single "short" is heard.

A whole minute is then allowed to elapse with no signal at all, but at 10h. 46m. os. a new series of signals is commenced –.. –.. –.., &c., until 10h. 46m. 55s. is reached, when again there is silence for a few seconds, and then a short tap at *exactly* 10h. 47m. os. Another minute of silence is then allowed to pass, and at 10h. 48m. os. a different series of signals is commenced –.... –.... –...., &c., terminating about 10h. 48m. 55s., when after a few seconds' silence the single tap that follows indicates *exactly* 10h. 49m. os.

Thus it will be observed that the hearer has not only three opportunities of correcting his timepiece, but if by chance he missed the first signal at 10h. 45m. os. he can identify the other minutes by the different signals which precede them.

In the case of the German signals transmitted from Norddeich-Wilhelmshaven, at about 12 o'clock midday and 10 o'clock in the evening, the procedure is quite different. The first notification is the transmission of a series of V's thus, ...– ...– ...–, &c., to give the hearers a chance to tune their instruments to the wave-length in use (about 1750 metres) if not already in adjustment. The "call" signal –.–.– is then sent out, followed by the "call signal" of the station transmitting, namely, Norddeich, thus –.– –. –.. (K N D). The fact that Greenwich mean time is being sent is given in the next signal in the form –– ––. ––.. (M G Z) where MGZ indicate Mittel Greenwich Zeit. At 11h. 58m. 38s. the signal –...– or attention is repeated, and then follows the following series of signals:

Commencing at 11h. 58m. 46s., a tap is heard at *every second* until 11h. 58m. 50s. is reached; then a short pause is made, and another series of taps from 11h. 58m. 56s. to 11h. 59m. os.; again another pause, and a third series from 11h. 59m. 6s. to 11h. 59m. 10s. Then follows a longer pause, and a similar series of taps is heard for each of the intervals 11h. 59m. 36s. to 11h. 59m. 40s., 11h. 59m. 46s. to 11h. 59m. 50s., and 11h. 59m. 56s. to 12h. om. os. A few seconds after the last tap the signal –..–. indicating the end of transmission is given.

The above two examples show what very different systems are in use for the distribution of time by radio-telegraphy. They serve further to indicate that unless some international scheme is at once brought into operation, many other different systems may be added.

The Paris International Conference has thus stepped into the breach at the right moment and brought out a scheme which will be universally adopted and commenced on July 1 of the present year.

It is proposed for the international scheme that Greenwich time should be used throughout, and that the time signals should be transmitted at exact hours. It was further arranged that there should be no overlapping, *i.e.* that no two stations should send out signals at the same hour, and that the same wave-length (about 2500 metres) should be universally adopted.

A preliminary list of stations that will be in active operation by July 1 is as follows, and the times at which they will transmit their signals are added:

	Greenwich civil time. Hours
Paris	0 (midnight).
San Fernando (Brazil)	2
Arlington (U.S.A.)	3
Manilla	4 (provisionally).
Mogadiscio (Italian Somaliland)	4
Timbuctu	6
Paris	10
Norddeich-Wilhelmshaven ...	12 (midday).
San Fernando (Brazil)	16
Arlington (U.S.A.)	17
Massowah (Erythrea)	18
San Francisco	20
Norddeich-Wilhelmshaven ...	22

Since September 1, 1912, radio-telegraphic time signals have been daily sent out from Chōshi, on the eastern shore of Japan. They are transmitted at 9 p.m. Japanese standard time, *i.e.* at Greenwich noon. This station will no doubt adopt the international scheme.

An important part of the scheme that is desired, and will ultimately no doubt be accomplished, is that both a day and a night signal can be received at any point on the globe.

Now as to the method which will be adopted for distributing the exact time at all transmitting stations.

To make the system quite clear, the accompanying figure (Fig. 1), taken from the report of the conference as recorded in the *Comptes rendus* (November 4, 1912, No. 19, vol. clv., p. 872), is shown. The reader is supposed to commence the time reckoning from the innermost portion of the spiral.

At three minutes before the hour—that is, at any hour at which the signals are intended to distribute the time—the transmitting operator sends out a series of successive similar preliminary signals, a repetition of the letter X in Morse –..– –..– –..–, &c. These commence at the beginning of the 57th minute, and continue until 57m. 50s. has been reached. Then, beginning at the 55th second, three longs are given at intervals of one second, each long *lasting one second*. In the 58th minute a short (lasting for a *quarter* of a second), preceded by a long commencing two seconds before, heralds every tenth second, and at the 55th second three longs as before are signalled. During the 59th minute two longs, preceding the quarter-second tap at every tenth second, are transmitted, and this minute concludes as before with the three longs at seconds intervals.

By following the spiral outwards and noting the positions of the longs and shorts in relation to

the divisions in seconds on the outer circle, the system can be easily understood.

It will thus be seen that each short signal or tap will give the receiver a chance of comparing his clock, and the dissimilar preliminary signals will inform him whether the minute involved is the 58th or 59th.

When all stations bring this excellent and very simple system into operation, it will be most easy for anyone unacquainted even with the Morse alphabet to check their clocks correctly.

Now while the above arrangements as regards the distribution of time will come into force on July 1 next, the questions as regards the type of weather messages, which will be transmitted directly after the time signals have been sent out, are not yet settled.

There is little doubt, however, that each transmitting station will send out a general description of the air movements over a wide area of which the station is about a centre, and also some definite data as regards certain specified stations useful for that area.

At the present time both Paris and Norddeich send out such messages, and it may be of interest to describe the procedure now followed at the former station, for it is probable that little, if any, change will be made with regard to the system there in vogue.

Let us suppose that the time signals at 10h. 45m. 0s., 10h. 47m. 0s., and 10h. 49m. 0s. have just been transmitted from the Eiffel Tower, then there follow immediately after them the weather signals. It may be mentioned again that the signals are sent through quite slowly, so that with a little practice they can be easily recorded and deciphered.

A typical message received in London on January 28, 1913, ran as follows:

(a) =BCM=R.51000=V.491424=O.551633=
C.621812=H.653043=S.46207=
Pression basse ouest Europe élevée nord==

(b) R.51000=V.491424=O.551633=
C.621812=H.653043=S.46207=
Pression basse ouest Europe élevée nord=

(c) Paris=vent 9 mètres stationnaire sud croît pression 758 stationnaire ciel couvert==

(d) V. 9 m ss sud cc pp 758 ss ciel couvert

Then follow the signals:

—.—. (end of transmission).

..—. .—.. (FL repeated several times, which denote Eiffel Tower).

And lastly

...—.— (end of work).

The above message has been divided into four sections and marked (*a*) (*b*) (*c*) (*d*), in order to show that (*b*) is simply a repetition of (*a*), and that (*d*) is a repetition of (*c*), only sent in brief, *i.e.* "V" corresponds to "vent," "m" to "mètres," "ss" to "stationnaire," &c.

In deciphering the message only (*a*) has to be considered, because (*c*) explains itself, being the general weather conditions at Paris stating the velocity of the wind in metres per second, direction of wind, pressure in millimetres, and state of sky. At 3 p.m. each afternoon a similar message, stating the meteorological conditions at Paris is transmitted from the Eiffel Tower.

With reference to (*a*), then, the message contains information relating to (1) atmospheric pressure, (2) wind direction and force, (3) the state of the sea, *in code* from the following six stations: Reykjavik (R), Valencia (V), Ushant (Ouessant) (O), Corunna (C), Horta (H) (Azores), for 7 a.m.; and for St. Pierre (S) (Miquelon, Newfoundland) for the preceding 8 a.m. (see Fig. 2).

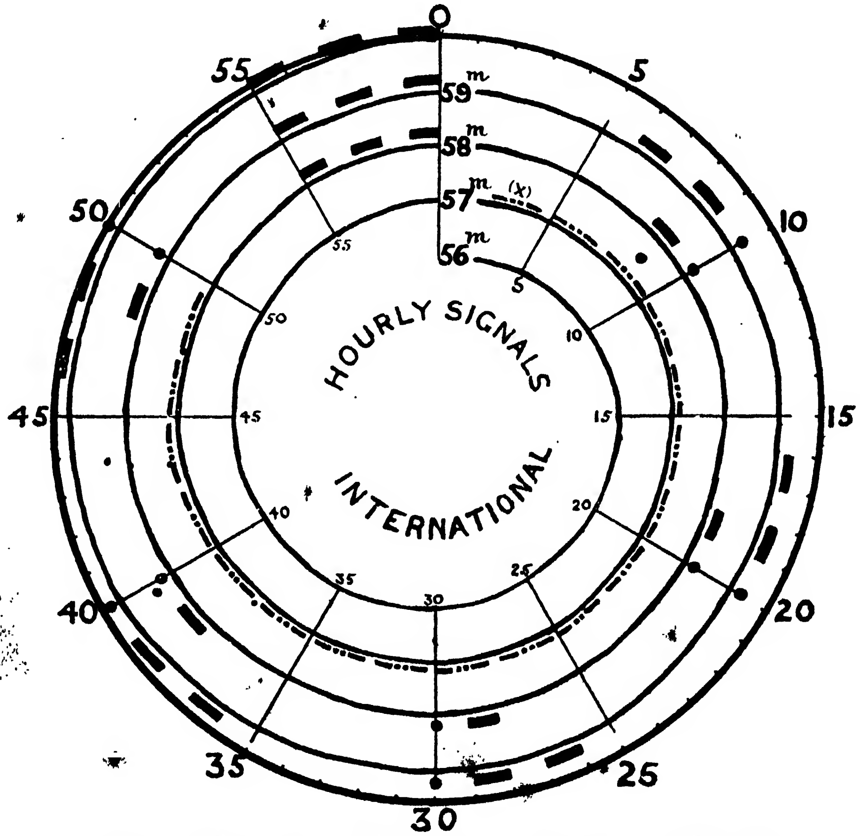


FIG. 1.—Diagram to illustrate the international system of radio-telegraphic time signals which will come into operation on July 1 of this year.

The coded part of the message is given in seven groups. The first group, BCM, stands for the Bureau Central Météorologique, and indicates the source of the information. The above-named stations are indicated by the single letters printed in brackets above.

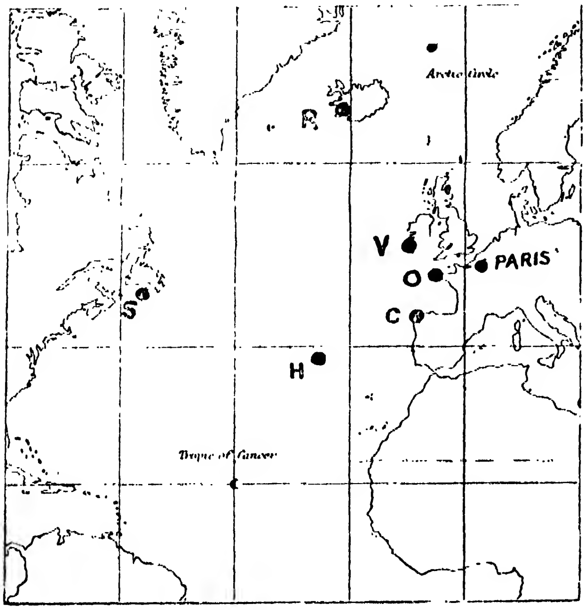


FIG. 2.—Chart showing the positions of the stations neighbouring the North Atlantic, the meteorological conditions at which are daily transmitted by radio-telegraphy from the Eiffel Tower. (See text for names of stations indicated.)

The first two figures in each group indicate the barometric pressure in millimetres, it being understood that 700 mm. should be added. The next two figures represent the wind direction in points of the compass as follows:—

Code No.	32	02	04	06	08	10	12	14	16	18		22	24	26		30
Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW

The fifth figure denotes the wind force on a scale ranging from 0, a calm, to 9, a hurricane. The sixth and last figure shows the state of the sea, a "calm" being denoted by 0 and "tremendous" by 9.

In the case of Reykjavik and St. Pierre, the sixth figure is omitted, no reports for transmission being available.

It sometimes happens that when the messages are being sent out from the Eiffel Tower, some of the data for some of the stations have not been received by the Bureau Central Météorologique, and therefore cannot be transmitted. In these cases the signal –..– or X is substituted for any unknown figure.

The following statement gives a full translation of the message marked (*a*) given previously, the code letters and figures being given in the first, third, fifth, seventh, and eighth columns.

Bureau Central Météorologique.

Letter	Station	Barometer		Wind			Sea
				Direction		Force Scale 0–9	Scale 0–9
R	Reykjavik	51	751	00	N	0	—
V	Valencia	49	749	14	SSE	2	4
O	Ouessant (Ushant)	55	755	16	S	3	3
C	Corunna	62	762	18	SSW	1	2
H	Horta (Azores)	65	765	30	NNW	4	3
S	St. Pierre	46	746	20	SW	7	

Low pressure west Europe high to the north.

It is impossible to overestimate the great value such messages can be to outward and homeward bound ships that receive them, for instead of having to gauge the approaching weather conditions from their own isolated observations they can form a far more accurate judgment by the deductions from the radio-telegraphic data.

While the distribution of time and weather signals will be of general utility, perhaps its most important value will be felt by sailors. Cut off from all shore communication with the exception of wireless, they will be put on nearly the same equality as land stations when the international system is in full swing.

WILLIAM J. S. LOCKYER.

NOTES.

IN the King's Speech at the opening of Parliament on Monday reference was made to the following matters, among others, to be brought forward during the session:—A guarantee from the Imperial Exchequer of a loan by the Government of the Sudan for the development therein of the industry of cotton-growing; proposals for the better care and control of the feeble-minded and for the further restriction of the industrial employment of children; proposals for the development of a national system of education. In the course of his comments upon the last-named subject, Lord Crewe remarked, in the House of Lords, that it is not the intention of the Government to endeavour to force through Parliament in this session a vast measure dealing with national education. "But in view of what has fallen from the Prime Minister, and also in view of the observations made by the noble and learned lord on the Woolsack at Manchester in the beginning of January, which were the sequel to a close inquiry into the subject, we think it is quite proper to place the country in possession of the general lines of our intentions during the coming session, although I do not suppose that we shall be able to proceed very far towards getting them

carried into law. We have not embarked on the consideration of the question without counting the cost or without realising that it will be necessary to provide more than is provided at present out of national funds towards the cost of education."

DR. DUGALD CLERK, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

THE Trustees of the Indian Museum have appointed Dr. N. Annandale as their representative at the International Congress of Zoology, to be held at Monaco this month.

THE ninth International Physiological Congress will be held at Groningen on September 2-6 next, under the presidency of Prof. H. J. Hamburger, professor of physiology in the University of Groningen.

MR. DAVID S. PRENTICE, superintending inspector, has been promoted to the post of chief inspector of the veterinary branch of the Department of Agriculture and Technical Instruction for Ireland.

THE death is announced at Paris, at sixty-nine years of age, of M. A. M. Picard, vice-president of the Council of State and an honorary member of the Institution of Civil Engineers. M. Picard was the author of several works on engineering subjects, and many comprehensive reports upon the achievements of arts and industry at the close of the nineteenth century and after.

AT a meeting of the council of the British Association, held on March 7, a vote of condolence with Lady White on the death of Sir William White, president-elect of the association, was passed. The presidency for the forthcoming meeting in Birmingham was considered, and subject, under the rules, to ratification at an extraordinary meeting of the council, to be held on April 4, Sir Oliver Lodge, F.R.S., will be nominated as president. There will be a meeting of the general committee on the same day to make the election.

AMERICA has lost a bacteriologist of great promise by the death, in his forty-fifth year, of Dr. P. H. Hiss, jun. After graduating in arts at Johns Hopkins and in medicine at Columbia, he was appointed in 1895 assistant in bacteriology at the College of Physicians and Surgeons at Columbia University. From that post he was promoted successively to an instructorship, adjunct professorship, and, in 1906, to the full professorship in that subject. Dr. Hiss was joint author of a widely used text-book of bacteriology, and had also published a series of technical studies. He was best known by his methods of detecting typhoid bacilli, and by his use of the leucocyte as a cure for pneumonia and erysipelas.

A MARBLE bust of the late Mr. Brian Houghton Hodgson, executed by Thornycroft in 1844, has been presented by his widow to the British Museum (Natural History). The bust, of which a photograph is given in Sir W. W. Hunter's "Life of Hodgson," represents Hodgson, who died in 1894, at the age of forty-four. By the gift of his natural history and anthropological collections made while British Resident at Khatmandu, in the first half of last century, and subsequently while living privately at Darjiling, Hodgson greatly enriched the museum, and it is therefore appropriate that his bust should find a home in the building, where it is to be placed, we believe, alongside that of Dr. Gray, at the entrance to the Upper Mammal Gallery.

THE Franklin Institute, Philadelphia, acting through its committee on science and the arts, recently made the following awards of the Elliott Cresson gold medal, the highest in the gift of the institute:—Dr. C. P. Steinmetz, of Schenectady, New York, in recognition of successful application of analytical method to the solution of numerous problems of first practical importance in the field of electrical engineering; Emile Berliner, of Washington, D.C., in recognition of important contributions to telephony and to the science and art of sound-reproduction; Dr. I. Randolph, of Chicago, Ill., in recognition of distinguished achievement in the field of civil engineering; Lord Rayleigh, O.M., in recognition of extended researches of signal importance in physical science; Sir William Ramsay, K.C.B., in recognition of numerous discoveries of far-reaching importance in the science of chemistry; Prof. Emil Fischer, of Berlin, in recognition of numerous contributions of fundamental importance to the science of organic and biological chemistry.

ONE of the largest of the great scientific and industrial congresses is to be held in London in the early part of June, 1915. This is the sixth International Congress of Mining, Metallurgy, Applied Mechanics, and Practical Geology. These congresses take place at intervals of five years, and the last, which was brilliantly successful, was held at Düsseldorf in 1910, previous congresses having been held in Paris and Liége. The attendance at the Düsseldorf Congress was more than 2000, and it is anticipated that the attendance in London in 1915 will be equally large. An influential committee has been formed to make the necessary arrangements, and the movement is being actively supported by the University of London, Imperial College of Science and Technology, Geological Society of London, Institution of Mechanical Engineers, Iron and Steel Institute, Society of Chemical Industry, Institution of Mining Engineers, Institution of Mining and Metallurgy, Institute of Metals, South Wales Institute of Engineers, Cleveland Institution of Mining Engineers, West of Scotland Iron and Steel Institute, Staffordshire Iron and Steel Institute, Sheffield Society of Engineers and Metallurgists, and by numerous firms interested in the various industries represented.

THE winter, as comprised in the period for the thirteen weeks ended March 1, is shown by the Meteorological Office to have been mild, wet, and somewhat sunless over the entire area of the United Kingdom. The excess of temperature was greatest in

the south-east of England, where the mean for the period was 3° above the average. In the Midland Counties and in the east of England the mean temperature was 2·5° above the average. The heaviest rainfall for the winter was 14·90 in. in the west of Scotland, which was followed by 14·70 in. in the south of Ireland, and 14·58 in. in the south-west of England. The greatest excess of rain was 32 per cent. above the average in the south-west of England, and about 25 per cent. in excess in the Midland Counties, the south-east of England, and in the north and south of Ireland. The sunshine for the winter was sixty hours deficient in the east and west of Scotland, but only about twenty hours deficient in the south-east of England. The temperature for the winter of 1911–12 was about equally in excess to that of the recent winter. The excess of the rainfall was everywhere greater except in the north of Scotland, where in 1911–12 there was a deficiency. In the south-west of England the aggregate rainfall in the winter of 1911–12 was 16·36 in., which was 5·29 in. more than the average. The duration of bright sunshine was also everywhere deficient in the winter of 1911–12, except in the north of Scotland. The characteristics of the last two winters were very similar over nearly the whole of the United Kingdom.

THE ninth International Zoological Congress will be held at Monaco, under the presidency of H.S.H. the Prince of Monaco, from Tuesday, March 25, to Saturday, March 29. The congress this year appears to be specially attractive, there being up to the present time above 500 members who have enrolled. Besides special communications which are to be made in the seven sections of the congress, questions of general interest will be discussed at the early meetings. One point the zoologists are specially asked to discuss, and in some way agree upon, is concerning the use of generic and specific names, as to whether in all cases zoological nomenclature should be given absolutely to the original generic and specific name, or whether exception should be made in certain time-honoured generic and specific names which are thoroughly familiar to every zoologist. No lengthy excursions are arranged, but there will be receptions held at the Oceanographical Museum, at the palace, and in other places in the principality. Included in the programme is a fête performance at the opera. The fee for attendance is 25 francs, and application should be made at an early date for particulars regarding hotel accommodation, &c., to the secretary, whose address until March 15 is Prof. Joubin, Oceanographical Institute, 195 Rue Saint-Jacques, Paris, and afterwards the Oceanographical Museum, Monaco.

IN the February issue of *Man* Messrs. M. Longworth Dames and T. A. Joyce describe a remarkable steatite relief acquired by the British Museum from the Swat Valley, on the north-west Indian frontier. It represents in a most artistic way the famous story of King Sivi, who saved a pigeon from a hawk, and to compensate the pursuer cut off pieces of his own flesh equal in weight to the bird. This is the only known representation of the story, and the acquisition of the relief is particularly interesting because, according to the Chinese Buddhist pilgrim, Hiouen Tsang, Asoka built a stupa in the land of Udyāna, the modern Swat Valley, to commemorate this incident. The discovery of the relief will now probably give a hint as to the position of the stupa. The writers point out that this story is also localised in the Indus Valley, and, being imported into Europe, was possibly the origin of the legend which formed the basis of "The Merchant of Venice."

REFERRING to Prof. R. T. Hewlett's article on the pasteurisation of milk, published in our issue for February 6 last (vol. xc., p. 623), "Paterfamilias" sends an account of a method of preserving milk he has found successful. The plan, which Prof. Hewlett considers very good, was to put the milk in an earthenware bottle with narrow neck, and to keep the bottle in a boiling water bath for twenty or thirty minutes, according to the size of the bottle. While still in the bath, a rubber stopper with a thistle funnel stuffed with cotton-wool was inserted in the neck and the bottle removed. As pointed out, however, in Prof. Hewlett's article, even with the precautions adopted by "Paterfamilias," in hot weather, unless *cooled* after treatment, the milk is liable to undergo very undesirable changes.

WE have been favoured with a cutting from *The Daily Malta Chronicle* of February 17, in which Mr. N. Tagliaferro, who has for some time been collecting fossil bones from a rock-fissure at Corradino, records the discovery of a large series of remains of giant land-tortoises. Most of these, it is stated, are referable to *Testudo robusta*, and the smaller *T. spratti* of Leith Adams. One of the specimens is, however, asserted to indicate a tortoise nearly half as large again as the biggest described example of the former, and may, it is suggested, represent a third species. These and other remains have been deposited in the museum at Valletta, and will, no doubt, be fully described in due course.

IT is announced in the Proceedings of the Philadelphia Academy for December, 1912, that the work of rendering the library and museum fireproof, which was undertaken through the aid of the Commonwealth of Pennsylvania, has at length been completed. As the library of natural history works is stated to be the largest in America, while the museum is particularly rich in type specimens, the importance of the achievement can scarcely be overrated. New quarters have been prepared for the entomological department, which are stated to meet all the requirements of workers; the department is devoting special attention to the economic aspects of entomology and the etiology of diseases due to insects.

IN the *Naturwissenschaftliche Wochenschrift* (xii., 5, February 2, pp. 65–69) Mr. H. Nachtsheim gives a valuable summary of observations and experimental work on the reproductive cycle of Rotifers. Most of the work has been done on *Hydatina senta*, and the greater part of his paper deals with this species. He reviews the earlier work of Maupas and Nussbaum, shortly summarises that of Punnett, and then dis-

cusses at greater length the experiments of Whitney and A. F. Shull, who have sought to determine what are the intrinsic and extrinsic factors which bring into existence male-producing and female-producing parthenogenetic females. It is concluded that while in many Rotifers, as Lauterborn has shown, there is a fairly regular cycle, in Hydatina external conditions, especially the chemical condition of the water, have much greater effect, perhaps because Hydatina lives in small pools which are more readily affected by environmental factors. Little is said about cytological observations, and the work of Lenssen, which is probably only in apparent contradiction of the later observations of Whitney, is not mentioned. Otherwise it appears to be a very complete and compact summary of our present knowledge of the subject.

PROF. G. KLEBS has forwarded a reprint of his recent important paper (*Verhandl. d. nat.-med. Ver.*, Heidelberg, 1912) on the morphology and phylogeny of the Peridineæ, a group of Protista which has in recent years received a vast amount of attention on account of the important part which these organisms play in the phytoplankton of both salt and fresh water. In this paper the author describes a number of new genera which are of remarkable interest as connecting up the typical Peridineæ with the Flagellate group Cryptomonadina, and showing also that on the other hand the Peridineæ have apparently given rise to Alga-like forms characterised by gradual loss of motility, and the development of resting colonies showing vegetative cell-division. He also discusses the possible affinities between the Peridineæ and certain groups of Algæ (Diatomeæ, &c.), and of Protozoa (*Infusoria, ciliata* and Radiolaria), and represents his views in a diagrammatic "family tree."

THE last number of the Bulletin of the Seismological Society of America contains two short accounts by Mr. G. A. Clark and Mr. A. G. McAdie of the eruption of the Katmai volcano in Alaska last June (vol. ii., pp. 226–229, 236–242). The volcano is a rather insignificant peak, less than 5000 ft. in height, and, before last June, was supposed to be extinct. The eruption began on June 6 at about 4 p.m., and was seen by several observers on the island of Kodiak, at a distance of seventy-five miles. A heavy fall of ashes took place during June 6 and two following days, but ceased about three days later. The town of Katmai, which was explored on June 14, was found to be buried in ashes to a depth of three or four feet, and on Kodiak island the thickness of the layer of ashes was more than a foot. Further eruptions occurred during each of the next four months, those of August 19 and October 25 being of some violence.

THE useful report on the state of the ice in the Arctic seas during 1912, published by the Danish Meteorological Institute, is of more than usual interest in view of the abnormal conditions which obtained in the North Atlantic in that year. It includes, as before, monthly summaries prepared from all reports received, and charts showing the condition of the ice during each of the months April–August. The winter of 1911–12 was on the whole mild in the region of Bering Strait and in Greenland, but cold in the European Arctic seas; in the White Sea there was much ice until the first half of June, and the Kara Sea seems to have been unapproachable all through the summer. In Barents Sea the edge of the ice throughout the summer was more westerly and southerly than usual. The coast of Iceland was quite free during the year, but the edge of the ice was not far off the northern shore. Vessels were able to put into Angmagsalik (East Greenland) about the third week in July, owing to there being no great drift southward of the vast masses of ice further north; a possible result may be a heavy drift this year. The conditions along the west coast of Greenland were about normal. Only few reports from Bering Sea and Strait were received, and none from the Beaufort Sea. On this account the institute makes an impressive appeal for more cooperation in its important work; during the year in question the available information was almost entirely received from Norwegian and Danish sources. The proposed publication by the Meteorological Office in its *Weekly Weather Report* of observations respecting the state of the ice off the east coast of North America during this season, received by wireless messages from the whaler *Scotia*, which has been chartered by the Board of Trade in conjunction with the North Atlantic steamship lines, will be an important step in the direction of the appeal of the Danish Meteorological Institute.

FROM the *Rendiconti* of the Royal Lombardy Institution we learn that the prize for airships, which was founded by the late Dr. Cagnola long before the days of aërial navigation, has again been unawarded, as has, indeed, been the case during practically the whole period of development of modern airships and dirigibles. The report of the referees on the work submitted by the solitary competitor, coupled with the absence of other competitors, seems to indicate that Italian aëronauts, as well as others competent to submit Italian, French, or Latin accounts of their successful experiments, are deterred from making any serious effort to compete for the prize, and this for some reason or other which is doubtless well known to them. The object which Dr. Cagnola had in view has been attained quite independently of his benefaction, and it is surely unfortunate that the latter has signally failed to further this end.

POSTAGE stamps do not often afford material for scientific discussion, but an interesting point is mentioned by Mr. Sam S. Buckley in his book on the marginal varieties of the Edwardian stamps of Great Britain (published by Oswald Marsh, London), in connection with a change that was initiated in the autumn of 1911 in the mode of perforating the new English issues. Until then the horizontal and vertical perforations were at the same distance apart, namely 14 in 2 centimetres. It was found, however, that the stamps would not tear well along the horizontal lines, and the explanation was that in machine-made paper the fibres have a tendency to lie in certain directions, thus making the resistance to tearing unequal in

different directions. A remarkable result of these experiments was the conclusion that the resistances could be equalised by using fifteen perforations horizontally to fourteen vertically, the extra perforation making all the difference.

WE have received a copy of a new illustrated catalogue of physical apparatus issued by Messrs. F. E. Becker and Co., Hatton Wall, E.C. It is a substantial quarto volume of more than a thousand pages, and covers most of the apparatus, from millimetre scales to electric motors, likely to be used in a physical laboratory, while the requirements of the engineer and miner are not forgotten. Some of the newer apparatus is described in detail, and instructions as to its use are given, as, for instance, in the case of the Bunsen ice calorimeter on p. 950, and of the stereo pyrometer on p. 1013.

THE first number of *Scientia* for 1913 contains two articles which throw doubt on the validity of the recently discovered sun-spot periods of five and eight years, and on the principle of relativity which has taken so prominent a place in recent theory. The first article is by Mr. E. W. Maunder, of Greenwich. The second article, by Prof. M. Brillouin, of the Collège de France, points out the slenderness of the foundation on which the theory of relativity has been reared, and maintains that the impossibility of detecting a relative motion of ether and matter, which forms the basis of the theory, is merely an experimental difficulty of the present time, and ought not to be elevated into a universal principle. Prof. Brillouin also takes exception to some of the more recent propositions stated by Prof. Einstein, as, for example, that energy has inertia and weight, and concludes that the principle of relativity introduces more difficulties than it solves.

THE *Verhandlungen* of the German Physical Society for January 15 include a short *résumé* by Dr. F. Reiche of the results he has obtained for the distribution of intensity in a fine spectrum line under various conditions. He considers a thin layer of a luminous gas the electron systems attached to the atoms of which are oscillating owing to the impact on them of electrons or atoms. The breadth of the line emitted is produced partly by damping due to radiation, and to inter-atomic forces, and partly to the motion of the emitting centres themselves in accordance with the kinetic theory of gases. As a result, he finds that the distribution of intensity is to a great extent determined by a parameter, which, if small, gives the distribution found previously by Lord Rayleigh; if large, a distribution the author proposes to call the "dispersion distribution." In the former case, increase of density of the gas or of thickness of the layer of gas leads to only a small amount of widening of the line, in the latter to a considerable widening. These theoretical conclusions have been verified experimentally.

A YEAR ago reference was made in NATURE to the elegant proof given by Willstätter and Escher that lutein, the yellow pigment of yolk of egg, was similar to, if not the same as, the xanthophyll present in leaves. In the interval other animal pigments have been investigated, and Dr. Escher now announces that the yellow pigment of the *Corpus luteum* is identical with carrotene, such as is present in carrots and leaves, and closely allied to lycopin, the colouring matter of tomatoes. Carrotene has been shown by Monier-Williams to form the yellow colouring matter of wheaten flour, and it is of interest to note that Escher states he has preliminary evidence that the yellow pigment of fat is similar in composition. Carrotene is an unsaturated hydrocarbon, $C_{40}H_{56}$, whereas xanthophyll has the formula $C_{40}H_{56}O_2$. The two classes of pigments are separated by shaking with a mixture of alcohol and light petroleum. The liquid forms two layers, the upper one of petroleum ether containing the carrotene, and the lower alcoholic layer containing the xanthophyll. The ovaries of no fewer than 10,000 cattle were required for the investigation, and yielded less than half a gram of pigment.

FIVE recent additions to the "Cambridge Manuals of Science and Literature" have been received from the Cambridge University Press. One volume, by Prof. J. H. Poynting, has on its cover, "The Earth," but an examination of the title-page shows that its shape, size, weight, and spin only are dealt with. In Mr. A. J. Berry's book, "The Atmosphere," the subject-matter has been restricted to the more purely chemical and physical phenomena, meteorology being omitted. Dr. Alex. Wood writes on "The Physical Basis of Music," and provides an elementary account of the principles of the subject. In "The Story of a Loaf of Bread," Prof. T. B. Wood gives a popular account of the subject so far as farming, milling, and baking are concerned. Mr. E. L. Attwood, writing from the naval architect's point of view, contributes a volume on "The Modern Warship." The volumes, which are each sold at 1s. net, appear to be addressed to the general reader, but it is to be feared that few such readers will be prepared to give the sustained attention which the treatment of the subject in most of the volumes demand. In accuracy and authoritativeness the books leave nothing to be desired, and as introductions to more advanced treatises the series may be recommended unreservedly.

A BRIEF account of the thirteenth meeting of the Australasian Association for the Advancement of Science, held in January, 1911, at Sydney, appeared in the issue of NATURE for February 23, 1911 (vol. lxxxv., p. 558). We have now received the official report of this meeting, edited by the permanent honorary secretary, Mr. J. H. Maiden, assisted by the secretaries of sections. It is an imposing volume of 766 pages, and is well and profusely illustrated with forty-eight plates, in addition to the illustrations in the text. The report provides excellent evidence of the industry and enthusiasm of Australasian men of science, and of this record of a year's work the association may well be proud.

OUR ASTRONOMICAL COLUMN.

THE USE OF A PLANE GRATING IN STELLAR SPECTROSCOPY.—In No. 5, vol. vi., of the Journal of the Royal Astronomical Society (Canada) there is an interesting note describing some preliminary tests, made at the Dominion Observatory, Ottawa, of a plane grating used as the dispersion piece of a stellar spectrograph. The grating used is one ruled by Dr. J. A. Anderson, who is now regularly ruling excellent gratings at the Johns Hopkins University, and has a ruled surface of $2\frac{7}{8} \times 3\frac{3}{4}$ in., with 15,000 lines to the inch. It was employed in the Littrow form of spectrograph, giving a linear dispersion of 17·5 Angströms per millimetre, and gave excellent definition over a nearly flat field extending from λ4800 to λ3500. The photographs secured show a much more uniform intensity over a wide range than do those taken with a three-prism spectrograph, and for this reason will be especially useful. In the red, where the prismatic spectrum is so compressed, and in the violet and ultra-violet, where it suffers considerable absorption, the grating spectrograph will prove very advantageous, and the results of the further experiments to be made will be awaited with interest.

OBSERVATIONS OF THE ZODIACAL LIGHT.—The February number of *L'Astronomie* contains two striking drawings of the zodiacal light as seen by Lieut.-Col. Pachine at Essentouki (Caucasus) on January 28, 1911. This observer has seen the phenomena many times, and in various countries, but had never before seen it so bright. At 6h. 30m. p.m., the base of the luminosity extended along the western horizon for a distance of some 30° from α Piscis Austr. towards Aquila, and the cone reached upwards to a point a little to the south of α Arietis, the brightness from the base to γ Pegasi being more than twice that of the Milky Way in its brightest parts. Many curious fluctuations took place, and at 9h. 40m. the apex of the cone enveloped the Pleiades. The colour of the light generally was from a pale-yellow to a bluish-grey.

ASTRONOMICAL TIME-INSTALLATIONS.—A brochure published by the Royal Observatory of Belgium contains a very detailed and well-illustrated account of the installations employed for the time-service in that observatory, written by MM. Philippot and Delporte. The various means employed to secure the necessary constancy of pressure and temperature in the underground chamber containing the installation are very interesting, as are also the various devices for automatic regulation and registration, and it would appear that the Belgian authorities have established an ideal installation for their time-service.

Amateur astronomers will find a useful note, by M. Jonckheere, in the January number of *L'Astronomie*, describing a device he employs for keeping his sidereal clock at constant temperature. The clock is placed in a double case, and should a change of temperature occur, a current is sent automatically through a heating circuit (an incandescent lamp bulb) until equilibrium is restored. With this apparatus M. Jonckheer keeps the temperature constant within 0·25° C.

ORNITHOLOGICAL NOTES.

IN the fifth part (vol. i.) of *The Austral Avian Record* the editor executes a complete *volte face* in the matter of the classification of Australian birds. Hitherto he has used generic terms in a wide and comprehensive sense; he now employs them in a much more restricted signification, and accordingly proposes no fewer than forty-eight new genera in this issue. Whether such changes be expedient or not (there is no right or wrong in the matter), they have the great disadvantage of rendering standard works, like Sharpe's "Hand-list of Birds," more or less obsolete.

In *The Zoologist* for December, 1912, Mr. F. J. Stubbs gives reasons for regarding migration as a cosmical function, which plays an important part in regulating the present balance of life on the globe. The prevalence of continuous sunlight during the Arctic summer and its absence in winter is regarded as the primary controlling factor of the phenomenon.

Bird-migration in Lindisfarne forms the subject of an editorial article in *British Birds* for December, 1912. Rather more than a hundred kinds of birds were observed on the island, of which not more than thirty seemed to be resident. Although no great inrush of birds was noticed, migration was going on during twenty-six out of the forty days of the visit. Bird-life in the south-west of Ireland and the recovery of birds marked in 1912 form two of the chief items in the January issue of the same journal.

Bird-marking in the Netherlands forms the subject of an article by Dr. E. D. Van Oort in Notes Leyden Mus., vol. xxxiv., p. 243. The number of birds marked in 1912 was considerably greater than in the preceding year. The record includes such birds of both years as have been recovered up to date, but the returns from correspondents were not complete when the article was written.

In the course of a narrative of a trip through South America, including a visit to Tierra del Fuego, which deals chiefly with ornithology, Mr. F. W. Blaauw (Notes Leyden Mus., vol. xxxv., No. 1) describes the nestling plumage of the so-called Coscoroba swan (*Coscoroba candida*), and its bearing on the affinities of the genus. The colour-pattern is intermediate between those of sheldrake and tree-duck chicks, the head-markings approximating to, and the body-markings being almost identical with, those of the latter. This tends in some degree to confirm the author's view that Coscorobas are practically overgrown tree-ducks.

It is satisfactory to learn, from a report by Mr. G. Bolam on the natural history of Hornsea Mere, published in the January number of *The Naturalist*, that the local birds are most efficiently protected by the keeper, who has occupied his post for thirty-two years. It may be noted that in 1911 fourteen bearded tits were introduced, some of which have nested and reared young.

In a long article on the "Hand-list of British Birds," by Dr. Hartert and others, published by Messrs. Witherby, *The Field* of March 8 strongly condemns the great changes in familiar nomenclature which form one of the most striking features in that work, referring especially to the inconvenience caused by transferring names long associated with well-known species to others. At the conclusion of the article it is suggested that those "who may be in doubt whether to accept or reject the list now under consideration will do well to await the appearance of a new edition of the B.O.U. List, which, we understand, is in active preparation. The simplest way out of the difficulty, as it seems to us, is to ignore the new list."

Last year schedules were distributed throughout the country with the object of obtaining data with regard to the alleged decrease during the last few years in the numbers of certain migratory species which regularly visit the British Islands. Although the returns are not so full or so numerous as is desirable, they afford a considerable amount of in-

formation in respect to England, which is summarised by Mr. M. Vaughan in the March number of *British Birds*. As the result of the inquiry it seems practically certain that a decrease—and this not merely local—has taken place in the case of several species, notably the whitethroat, the redstart, the marten, the swallow, and the wryneck. No attempt is made to explain the diminution in numbers, which we have heard attributed, at least in the case of some species, to shooting and netting on the Continent.

In the February number of *The Zoologist* Mr. J. M. Dewar records further observations on the manner in which oyster-catchers open mussels and other bivalves. Mussels seldom open their shells wide enough to enable the bird to introduce its beak, except by the way of the gap for the byssus, and when this is not accessible, the oyster-catcher resorts to careful tapping, which causes the mollusc to rotate one valve on the other, and thus afford an entrance for the beak. Small mussels are frequently hammered to pieces by repeated blows with the beak.

Nos. 6 and 7 of *The Austral Avian Record* are devoted to a list of the species of Australian birds named by John Gould, and the present location of the type specimens, drawn up by Messrs. Witmer Stone and Mathews. The Gould Australian collection was sold in 1847 to Dr. T. B. (not J., as has been stated) Wilson, of Philadelphia. The type specimens are for the most part in the museum of the Philadelphia Academy; although the greater part of those of species named by Gould subsequently to the 1847 sale are in the British Museum. Gould named 426 or 427 Australian birds (both numbers are given at the end of the list) of which 341 stand, either as species or subspecies. The list will be valuable to systematic ornithologists.

In his presidential address to the Royal Australasian Ornithologists' Union, as reported in *The Emu* of January, Mr. J. M. Mellor emphasised the necessity of continued bird protection and the working of the present Act. A serious defect in this is the opportunity afforded by merely partial protection for a heavy destruction of certain species during the Christmas holidays.

In *Science* of February 27, Dr. R. W. Shufeldt announces a forthcoming memoir on the Pleistocene avifauna of the Oregon desert, in which three extinct species will be described. R. L.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE.

Crosby Lockwood and Son.—Agricultural Arithmetic: An Elementary Handbook for Farmers and Farm Students, containing Important Data and Calculations bearing upon the Science and Practice of Agriculture, with Special Reference to Dairying, J. C. Newsham and T. V. Philpott. *John Murray.*—A Pilgrimage of British Farming, A. D. Hall, illustrated. *T. Fisher Unwin.*—Mozambique: its Agricultural Development, R. N. Lyne, illustrated. *John Wiley and Sons (New York).*—Agricultural Drafting, C. B. Howe; Exercises on Dairying, Prof. C. Larsen.

ANTHROPOLOGY.

John Bale, Sons, and Danielsson, Ltd.—Some Austral-African Notes and Anecdotes, Major A. J. N. Tremearne, illustrated. *The Cambridge University Press.*—Folk Song and Dance, Miss Neal and F. Kidson; Brands Used by the Chief Camel-owning Tribes of Kordofán: a Supplement to the Tribes of Northern and Central Kordofán, H. A. MacMichael, illustrated. *W. Heinemann.*—Pedagogic Anthropology, S. M. Montessori. *G. Fischer (Jena).*—Die Anthropologie in ihren Beziehungen zur Ethnologie und Prähistorie, Prof. O. Schlaginhaufen. *Macmillan and Co., Ltd.*—The Golden Bough: a Study in Magic and Religion, Prof. J. G. Frazer, third edition, revised and enlarged; Part vi., The Scapegoat; Part vii., Balder the Beautiful; The Belief in Immortality and the Worship of the Dead, Prof. J. G. Frazer: Vol. i., The Belief among the Aborigines of Australia, the Torres Straits Islands, New Guinea, and Melanesia, the Gifford Lectures, St. Andrews, 1911–12. *Methuen and Co., Ltd.*—The Ancient History of the Near East from the Earliest Period to the Persian Invasion of Greece, H. R. Hall, illustrated. *Oliver and Boyd (Edinburgh).*—The Antiquity of Man in Europe, being the Munro Lectures on Anthropology and Prehistoric Archæology in connection with the University of Edinburgh.

BIOLOGY.

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RECENT ADVANCES IN SCIENTIFIC STEEL METALLURGY.[1]

TO render clear the exact nature of certain modern scientific advances in steel metallurgy it is necessary briefly to consider what is known of the past history of steel, more particularly with reference to cutting implements, whether for the purposes of peace or war. That steel (or, to be more accurate, probably steely-wrought iron) was known to the ancients, say, 3000 years ago, seems to be proved by a passage translated by Pope from the ninth book of Homer's "Odyssey":—

"And as when armourers temper in the ford
The keen-edged pole-axe, or the shining sword,
The red-hot metal hisses in the lake
So in his eyeballs hissed the plunging stake."

As has been truly remarked by Roscoe and Schorlemmer, the above description can be applied only to steel—that is to say, to iron containing a very considerable percentage of carbon.

So far as definite records are concerned, the story of early British steel metallurgy is wrapped in profound obscurity, and its history can be only indirectly surmised from collateral historical evidence. About A.D. 60 a great British army under the command of Queen Boadicea stormed the Roman camp at Colchester and annihilated the Ninth Legion. She then marched on St. Albans and London, and in both places put the garrisons and the Roman colonists to the sword, the stake, or the cross. Tacitus, the Roman historian, records that the losses of the Romans and their allies in these battles reached the startling total of 70,000 people. In the subsequent campaign, which ended in the defeat and death of the heroic British Queen, the same historian states that the British lost 80,000 persons.

It is evident, therefore, that Boadicea must have commanded at least 100,000 British troops, or she could never have undertaken such extensive and formidable military operations. It is also clear that these troops were armed with swords and spears, to say nothing of the scythes attached to the axles of their war chariots. There is no reason to suppose that these weapons were not of native manufacture. They would partly be made of bronze and partly of steely-iron, since the country had been for a century occupied by Roman soldiers and artisans. It is therefore almost certain that in the first century the manufacture of steely-iron weapons and implements would be on a fairly large scale, and would doubtless mainly be concentrated in iron ore and charcoal-producing districts, such as Sussex and the Forest of Dean.

In connection with Sheffield—now the greatest British steel centre—the earliest written record refers to the twelfth century, and states that in 1160 the monks of Kirkstead Abbey had somewhat extensive works at Kimberworth, near Sheffield, manufacturing wrought-, and, no doubt, steely-irons. In 1386 Chaucer, in "The Reve's Tale," in describing a miller of the time of Edward III., wrote, "A Shefeld thywtel bare he in his hose." Since 1386 Sheffield steel in the form of table knives has been in almost everybody's mouth. In 1590 Peter Bales, "The Writing Schoolmaster," recommends Sheffield razors and penknives for the cutting of quill pens. It is obvious that for this purpose fine steel carrying a perfect cutting edge is necessary, and was being made at Sheffield prior to 1590. Hunter states that in 1615 Sheffield workmen could make armour only fit for the common man-at-arms. The armour for knights was imported from Spain and Italy. Scott, in "Ivanhoe," embodies this fact in his description of the siege of "Torquilstone":—

"Thrice did Locksley bend his shaft against De Bracy, and thrice did his arrow bound back from the Knight's armour of proof. 'Curse on thy Spanish steel coat,' said Locksley. 'Had English smith forged it, these arrows had gone through an as if it had been silk or sendal.'"

The opening scene in "Ivanhoe" was near Woodhouse (five miles east of Sheffield), where, until quite recently, wrought-iron was manufactured at the Rotherwood Iron Works.

In 1760 Horace Walpole, writing to George Montague, remarks: "I passed through Sheffield, which is one of the foulest towns in England in the most charming situation. There are two-and-twenty thousand inhabitants making knives and scissors. They remit eleven thousand pounds a week to London. One man there has discovered the art of plating copper with silver. I bought a pair of candlesticks for two guineas, that are quite pretty."

Antiquarians express the opinion that the remarkable concentration of the cutting-steel industry round Sheffield was due to the juxtaposition of coal and iron ore in the district. This reason, however, is quite unconvincing to metallurgists; first, because charcoal and not coal was used, and, secondly, because the local ore produces an iron high in phosphorus, from which it is practically impossible to make cutting implements of fine steel. There is little doubt that the main factor which originally determined the location of the chief British steel industry at Sheffield was the unique situation of the town in a hollow near the confluence of four rivulets into the Don. Along these streams, running down the valleys of the Sheaf, the Porter, the Rivelin, and the Locksley, the old Sheffield steel-workers could, by the construction of numerous dams, get water-power for their forging hammers and grinding wheels at a small cost, and waterwheels worked by some of these dams are still in operation along these valleys, that of the Don itself actuating tilt-hammers and grindstones.[2] The latter are made from the carboniferous sandstones of the district. There is proof positive that the basis metal, consisting of nearly pure iron, from which the best Sheffield cutting steels are still made, was being imported into the town in the sixteenth century from abroad.

Among entries in the accounts of the Sheffield Church burgesses for the year 1557 is the following:—

'Paid to Robert More for one stone and quarter of Danske Yron XXIId. Paid to ye same Robt. for X lib of Spanysche Yron XV."

In modern money the cost of this raw material works out to at least 60*l.* per ton, or 3*l.* per cwt.[3] The Danish (Danske) iron was probably Swedish, just as at present much of the Danish butter imported comes from Swedish dairies.

In connection with the early importation of pure Swedish or Spanish iron for a basis metal, it is significant that in 1442 Sheffield obtained a Royal warrant to construct towpaths to make the River Don navigable. This river runs into the Humber at Goole, and there is little doubt that so early as the fifteenth century Sheffield steel-makers were endeavouring to replace the costly packhorse transit of foreign raw

[1] Discourse delivered before the Royal Institution on Friday, January 4, by Prof. J. O. Arnold, F.R.S.

[2] There is evidence in old documents that the name Sheffield may be a corruption of "Escafeld," meaning "the field of waters."

[3] Prof. Thorold Rogers in his Oxford lectures, 1888–9, stated that about 1685, using a multiplier of 2, the value in modern money of English wrought-iron was about 73*l.* per ton. The Sheffield record, however, proves beyond doubt that in 1557, *or more than a century and a quarter earlier*, the imported and superior Spanish and Swedish irons were commanding in Sheffield, retail, not more than 14*l.* per ton, which, using a multiplier of 4.5, is equivalent in present money to 63*l.* per t

materials by cheaper water carriage from the Humber.

It is next of interest to consider how, during the fourteenth, fifteenth, sixteenth, seventeenth, and half the eighteenth centuries, Sheffield made all its fine steel. It seems almost certain that the nearly pure imported Swedish or Spanish irons were carburised "in the dry way," by cementation in charcoal at a yellow heat. The highly ductile bar iron and the blistered and brittle steel resulting from its cementation-carburisation were described. The blister bar was then made into what for perhaps two hundred and fifty years has been known as "shear steel."

(The method of producing from blister bar both single and double shear steel was then described.) The origin of the name "shear steel" was due to the fact that British cloth-workers insisted on having this fine quality of steel for their cloth-cutting shears, and this material is still branded with rude representations of clothiers' shears. One pair of shears signifies single shear and two pairs double shear steel. The chemical composition of this steel, which is the purest made, is as follows:—Carbon 1·00 per cent; silicon, 0·03 per cent.; manganese, 0·07 per cent.; sulphur, 0·01 per cent.; phosphorus, 0·015 per cent. With its high reputation built up during centuries this material has naturally had its name branded on inferior kinds of steel. Indeed, bars of steel up to 6 in. in diameter have been sold as "shear steel" at 18*s*. per cwt., the price of the raw material from which shear steel is manufactured. Probably a bar 1½ in. in diameter marks the advisable limit of size for genuine shear steel, and its average market price is about 45*s*. per cwt.

The year 1740 marked for Sheffield, and indeed for the world, the beginning of an epoch of great metallurgical importance. Benjamin Huntsman, a well-known clockmaker of Doncaster, found that shear steel, on account of its sometimes varying temper and of its weld-lines, often presented uneven hardness and exasperating flaws when made into clock springs. He consequently determined to make a steel even in texture and free from weld flaws. He experimented successfully, and worked out a method for the production of sound steel ingots by the fluid or crucible process, and so founded in Sheffield an industry, destined to become world-wide, which soon extended the fame of Sheffield steel throughout the civilised world.

(A composition typical of crucible cast-steel was then given. It is less pure than shear steel, but sounder, being free from weld-lines. It is said that the famous American, General Sherman, when asked to "spare the good Indians," replied that the only good Indians he had ever met were dead Indians. Be this as it may, it is certain that no steel can be good unless it is properly "killed," or, in other words, "dead melted."

Fig. 1 shows two crucible steel ingots of identical composition and weight when poured in a "lively" and in a "killed" condition. Ignoring the "pipe," or central contraction cavity, the killed steel is quite solid, whilst the unkilled metal is riddled from end to end with gas cavities or "blowholes," containing, under pressure, hydrogen, carbonic oxide, and nitrogen gases, evolved in the plastic steel during solidification, and thus rendering the ingot commercially worthless. The sound and hence apparently much smaller ingot has been "killed" by the presence of a trace (say 0·01 per cent.) of metallic aluminium. The scientific explanation of this, the most remarkable phenomenon in the whole range of steel metallurgy, may be found in text-books or in reports of metallurgical lectures, but the present lecturer must confess that he is no nearer a convincing solution of this problem than when he began his researches twenty-five years ago.

It is next necessary to correlate the chemical and micrographic analyses of the plain carbon steel upon which the world depended for its cutting implements from the time of Homer to 1870.

FIG. .

The structure of pure Swedish iron is usually contaminated with a little slag. Ignoring this, the mass consists of white allotrimorphic crystals of iron with optically black boundaries.

In a micrograph of nearly pure iron containing about 0·4 per cent. of carbon, almost half the mass consists of the dark-etching compound constituent pearlite.

The structure of nearly pure iron containing 0·89 per cent. of carbon consists entirely of pearlite, a mechanical mixture of 87 per cent. of iron with 13 per cent. of normal carbide of iron, Fe_3C. The mass abrasion hardness of normal pearlite is about 4·5—that is, between fluorspar and apatite on Moh's mineral scale.

We have next to consider the phenomena known as the hardening and tempering of steel.

Figs. 2 and 3 show very clearly the beginning, the progression and end of the hardening of steel—that is to say, the transformation (during a thermal amplitude of perhaps 3° C.) of the compound constituent pearlite ($21Fe+Fe_3C$) to the micrographically amorphous constituent hardenite, which corresponds to the empirical figures $Fe_{24}C$, in which the carbide of iron, owing to the quenching, is trapped in some molecular association with the whole of the iron. The constituent hardenite has a hardness of 7 on Mohr's mineral scale—that is to say, it is as hard as quartz, flint, or rock crystal.

It is a little difficult to realise how much the thermal capability of the mineral pearlite (with a hardness of 4·5) to transform itself into the igneous rock hardenite (with a hardness of 7) has contributed to the advance of civilisation and to the material well-being of the human race. But unfortunately it was

found that hardenite was thermally very unstable, and that its cutting powers were greatly limited by the fact that the heat of friction in turning operations caused the hardenite to revert largely to relatively soft pearlite at a blue heat, say, 300° C. This property naturally limited the operations of engineers as to speed, as to traverse, and as to depth of cut, and consequently as to the cost and rate of output of all the engines and appliances necessary to our modern civilisation.

(A tempering diagram was then explained in which the black areas show the evolution of the latent heat of hardening, and consequently the transformation of the quartz-like hardenite to soft pearlite. This change at about 250° C. acquires a marked increase in velocity which reaches a maximum at about 300° C. Here the soft pearlite becomes the predominant partner, and the cutting power of the mass has practically vanished.)

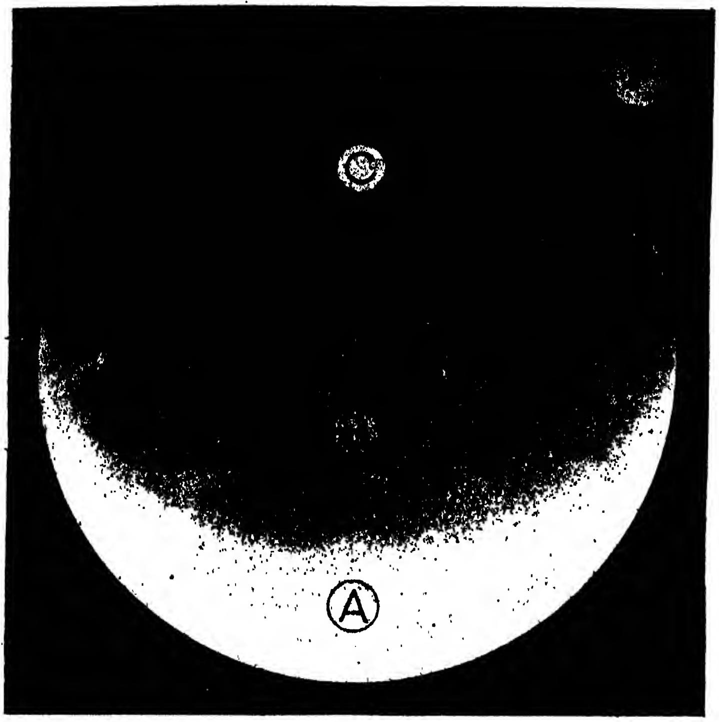
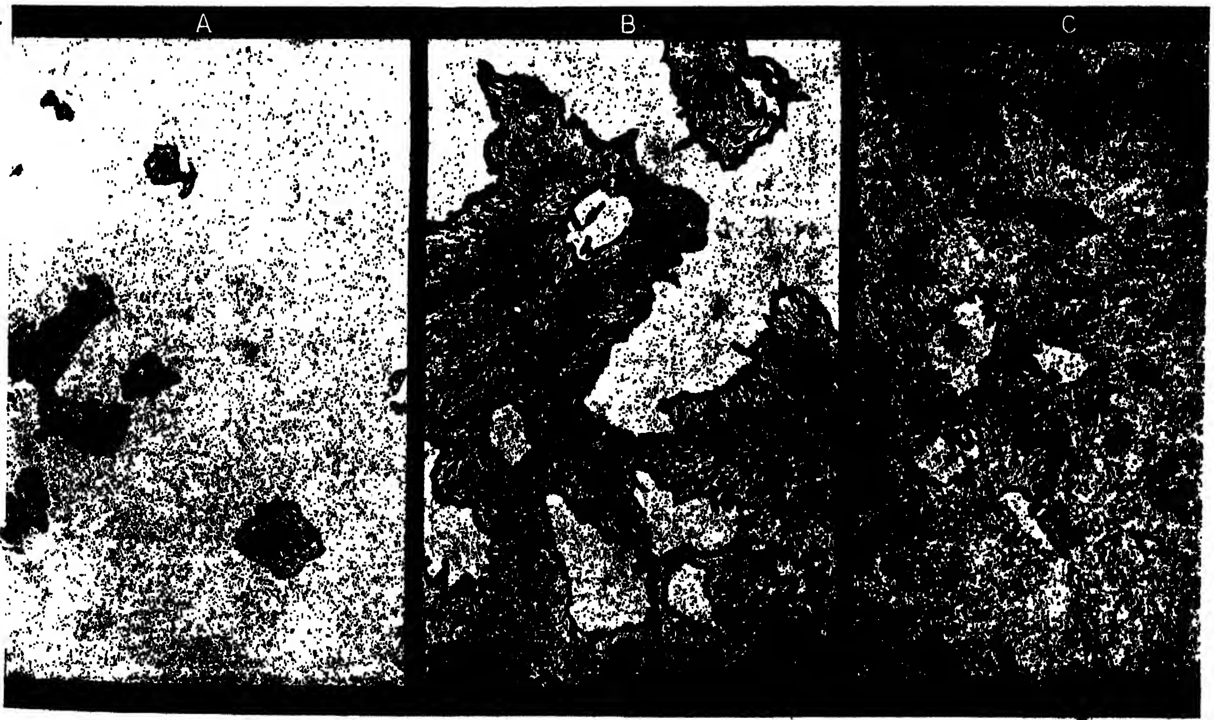


FIG. 2.—Carbon 0·89 per cent. The edge A was quartz-hard, stripping file teeth. The edge C was quite soft to the file. Etched ⅝ in. diameter disc. Magnified about 12 diameters after differential heating and rapid quenching. For high-power magnification see Fig. 3.

About the year 1870 marked the first beginnings of an epoch in cutting-steel metallurgy, which may be called the tungsten-chrome era. Robert Forrester Mushet, at the Clyde Works, Sheffield, began to manufacture on a considerable scale his "self-hardening steel." Mushet had practically discovered that when carbon steel was alloyed with a large percentage of tungsten, it, when cooled from a yellow heat in a draught of air, was not only sufficiently hardened, but, owing to the fortifying action of the tungsten on the carbon, the hardenite was thermally considerably more stable than that of plain carbon steel.

It is probable that in Mushet's early steels the "letting-down" point



Transformation nearly completed. Temperature about 730° C. Transformation half completed. Temperature about 729° C. Transformation beginning. Temperature about 728° C.

FIG. 3.—Pale areas, hardenite. Laminated areas, normal pearlite. Dark borders, troostitic pearlite. Carbon 0·89 per cent. Magnified about 450 diameters.

of the hardenite was raised to a temperature of perhaps 400° C., thus enabling engineers to take bigger cuts and work at higher

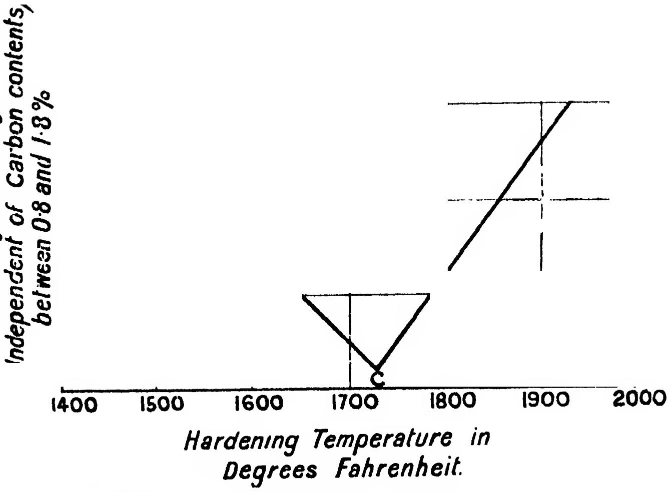


FIG. 4.—Physical diagram claimed by Messrs. Taylor and White for tungsten-chrome steels

speeds. Later, about 1880, Mushet still further fortified his hardenite by the addition of relatively small percentages of chromium, and between 1880 and 1900 self- or air-hardening steels were produced by many steel manufacturers in considerable variety.

In connection with cutting steels, a profound sensation was made throughout the steel world when, at the Paris Exhibition in 1900, the Bethlehem Steel Co. of America showed turning tools made under the alleged patent of Messrs. Taylor and White, cutting very mild steel at a speed which rendered the nose of the tool red-hot. It was obvious that in these tools the thermal stability of the hardenite had been raised to perhaps 600° C. The chemical compositions in the patent embodied nothing which had not been included in the Mushet type of steel for a period of about twenty years prior to the date of the American patent. In fact, what Taylor and White had really done was to show that this type of steel was capable of retaining its cutting edge at a much higher temperature than most engineers and metallurgists had realised. For this demonstration every credit is due to the Bethlehem Company.

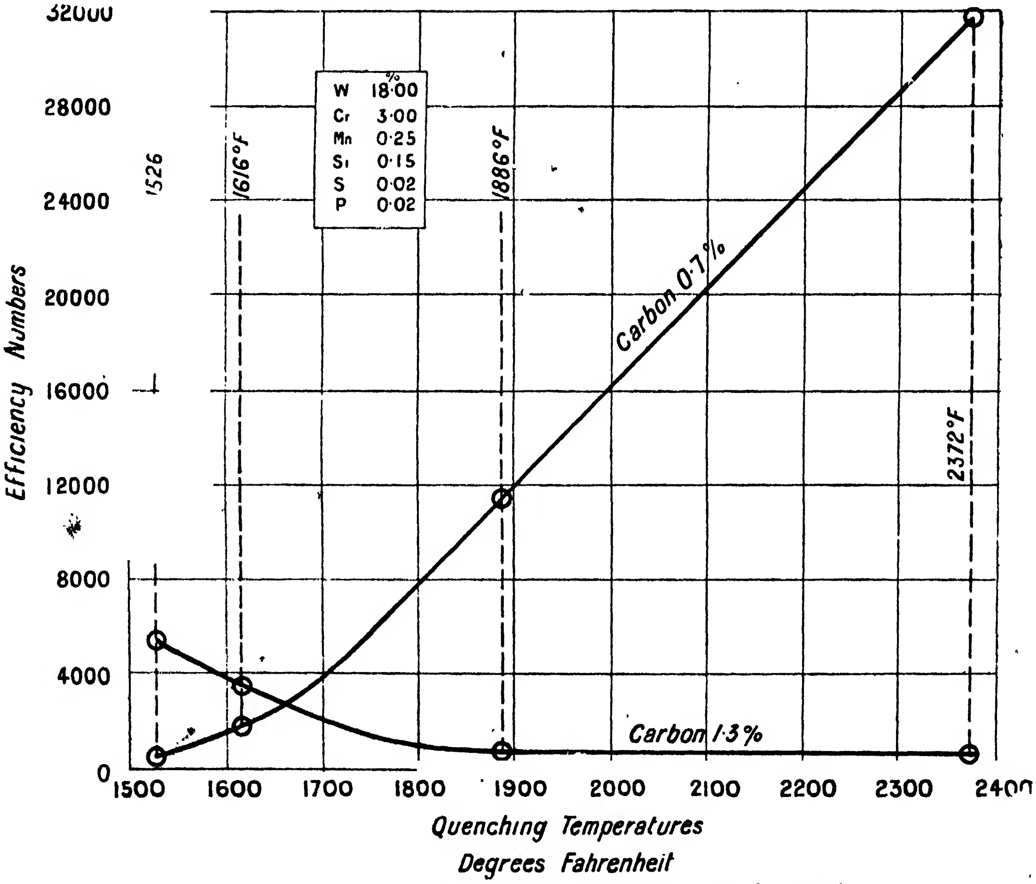


FIG. 5.—Physical curves obtained by Arnold and McWilliam for tungsten-chrome steels

Sheffield steel-makers, realising future possibilities, made from the year 1900 and onwards a series of experimental researches which eventually gave to engineers that astounding material known as high-speed steel, in which the thermal stability of the fortified hardenite was raised to about 700° C., and the striking difference in chemical composition between Mushet's and high-speed steels was shown; nevertheless, the latter are merely a progressive experimental development of the former.

The claims of the Taylor-White patent were the subject of a protracted lawsuit, the costs of which were about 50,000*l*. In the end, Mr. Justice Cross, of the United States Circuit Court, in a lengthy and luminous judgment, pronounced the Taylor-White patent to be absolutely invalid. Nevertheless, it is still claimed that the patent in suit was utilised by British manufacturers in producing modern high-speed steel. It is, therefore, only fair to consider what this patent really claimed.

Fig. 4 shows a physical curve of tungsten-chrome steels which the patentees claimed to have discovered. The coordinates are vertically the

cutting efficiencies of tungsten-chrome steels with any carbon from 0·8 to 1·8 per cent. (the amount being a matter of indifference), and horizontally the hardening temperatures in degrees Fahrenheit. The short horizontal line "A–B" between 1500° and 1550° F. was alleged to be the range in which, prior to the patent, all tungsten-chrome air-hardening steel had been hardened. The falling line "B–C" between 1550° and 1725° F. was stated to be the breaking-down range discovered by the patentees, along which the cutting power of the steel steadily deteriorated. Then along the rising line "C–D," from 1725° to 2000° F (the maximum temperature specified in the patent), the quality of the steel improved as the temperature of hardening rose, until in the higher part of this range the turning tools had an efficiency never before achieved in the art, and in effect (to use the words of Coleridge's "Ancient Mariner") the patentees claimed:

> We were the first that ever burst
> Into that silent sea.

My late colleague, Dr. A. McWilliam, and I were commissioned to investigate at Sheffield University the accuracy or otherwise of the curve specified in the patent. The results are embodied in Fig. 5. The coordinates are, horizontally hardening temperatures in degrees F., and vertically cutting efficiency numbers obtained by the approximate and relative formula $c = t \times s^2$, where e is an efficiency number, t the time endurance in minutes, and s the cutting speed, *caeteris paribus*, in feet per minute. It will be seen that with a steel containing about 17 per cent. of tungsten, 3 per cent. of chromium, and 1·3 per cent. of carbon, the maximum efficiency number of about 5000 is obtained at the lowest temperature, 830° C., after which the higher the hardening temperature the less the efficiency number, which at 1300° C. or 2400° F. has fallen to 500, or only twice the efficiency of plain carbon steel. In a similar steel, containing, however, only 0·7 per cent. of carbon, the efficiency number at 830° C. is only about 500, but the efficiency steadily rises with the hardening temperature, until at 1300° C. or 2400° F. it reaches the astounding number of about 32,000. In a word, there is no breaking-down range, and so far from the percentage of carbon being immaterial the cutting efficiency is actually a function of the carbon and hardening temperatures.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The council, in accepting the resignation by Prof. J. H. Poynting of the office of dean of the faculty of science, has passed the following resolution:—"That this council deeply regret the illness which has deprived them of the greatly valued and long-continued services of their former colleague, Dr. Poynting, at their meetings, and earnestly trust that his health, now happily restored, may be preserved for many years."

Prof. Barling has resigned the chair of surgery on his election as Vice-Chancellor.

Dr. Alfred H. Carter has resigned the chair of medicine, and the following resolution has been passed by the council:—"That the council accepts with great regret the resignation of Dr. A. H. Carter of his appointment as professor of medicine in this University. It desires to thank him for his valuable services not only as teacher during the past twenty years, but also for the great assistance he rendered in promoting the union of the medical faculty of Queen's College with Mason College, a step which materially advanced medical education and the University idea in Birmingham."

CAMBRIDGE.—The following is a summary of benefactions received by the University during the year ended December 31, 1912:—

	£	s.	d.
Gonville and Caius College, towards the maintenance of the new buildings for physiology and experimental psychology	500	0	0
Dr. J. B. Hurry, St. John's College, for the endowment of a research studentship in physiology to be called the Michael Foster research studentship	1100	0	0
Anonymous, for the endowment of the Arthur Balfour professorship of genetics	20,000	0	0
Balfour Library Endowment Fund, subscribers to	2302	3	2
Col. W. Harding, for the endowment of a lectureship in zoology	1100	0	0
St. John's College, towards the equipment of the Solar Physics Laboratory on its installation at Cambridge ...	500	0	0
Anonymous, for the purpose of increasing the stipend of the director of the Fitzwilliam Museum	100	0	0
	£25,602	3	2

In addition, sums amounting to about 10,000*l.* have been presented to the University. These include 5000*l.* from Mr. Otto Beit, 1000*l.* from the Mercers' Company, 1000*l.* from Messrs. Rothschild and Son, and 200*l.* from Mr. Almeric Paget, M.P., for the new school of physiology.

The Vice-Chancellor gives notice that he has appointed Saturday, April 19, as the day for the election to the Plumian professorship of astronomy and experimental philosophy vacant by the death of Sir George Darwin. Candidates for the professorship are requested to send their names to the Vice-Chancellor on or before Friday, April 11.

The director of the Solar Physics Observatory has, with the consent of the Vice-Chancellor, appointed the following to be members of the staff of the Solar Physics Observatory:—F. J. M. Stratton, to be assistant director; C. T. R. Wilson, to be observer in meteorological physics; F. E. Baxandall, to be first senior observer; C. P. Butler, to be second senior observer; W. E. Rolston, to be first junior observer; W. Moss, to be second junior observer.

LEEDS.—Arrangements are being made for the establishment of a Yorkshire Summer School of Geography to be organised in alternate years by the Universities of Leeds and Sheffield. The course for 1913 will be held at Whitby, from August 4–25, under the auspices of the University of Leeds. The aims of the course are to provide instruction which shall equip students for attacking problems in the regional geography of any area, and to discuss and elucidate problems connected with the teaching of geography. The work of the school will include field work, laboratory work, and lectures on geological, meteorological, economic, and historical aspects of the geography of Yorkshire. The agricultural, mining, textile, and metallurgical industries will be dealt with, as well as questions connected with language and place-names. Further information will be available in June, on application to the secretary, Summer School of Geography, the University, Leeds.

In September next Prof. H. R. Procter will retire

from the chair of applied chemistry (chemistry of leather manufacture) which he has held for the past twenty-two years. Prof. Procter is prepared and desirous to continue in an honorary capacity the researches into the chemistry of the tanning process and the behaviour of colloids, on which he has been engaged. To commemorate the great services he has rendered to leather industries it is therefore proposed to erect and equip an International Research Laboratory, of which he will be honorary director so long as he desires to continue his investigations. The laboratory will be open, without charge, to competent students from every part of the world. The council of the University has provided a site, and an influential committee, representing the scientific and commercial sides of the leather industry, has been formed to appeal for subscriptions. The sum desired is 4000*l.* for the establishment of the laboratory, and 300*l.* a year for current expenses and assistance. The honorary treasurer of the committee is Mr. W. J. Rivington, *The Leather Trades Review*, 24 Mark Lane, London, E.C.

The University is to receive a grant of 1000*l.* a year through the Board of Agriculture from the Development Fund for investigations into the subject of animal nutrition. The work is to be carried out in consultation with the existing Research Institution at Cambridge, so that there shall be no unnecessary overlapping between the two schemes.

Science announces that gifts amounting to more than 100,000*l.* to Washington and Lee University, Lexington, Va., are provided for in the will of Mr. R. P. Doremus, who died on February 1.

THE council of the University of Bristol has been informed that the late Mr. Augustus Nash has bequeathed the residue of his estate in trust to pay a near relative the income during life, and afterwards to pay the capital sum to the University in the hope that it may be used to advance natural sciences, particularly chemistry. The sum will be about 18,000*l.*

IT will be remembered that, in 1909, the Goldsmiths Company gave 50,000*l.* towards the extension of the engineering department in the Central Technical College. The company has now offered to pay the entire cost of the new building, which means an added gift of 37,000*l.* The Goldsmiths' Company has attached the condition that the portion of the capital belonging to the Imperial College of Science and Technology which will be thus set free shall be added to the endowment fund, the income being used for higher educational and research work.

A MEMORIAL signed by a large number of educationists and others has been presented to the Prime Minister urging the need for an immediate reform of our national education. The petition states that the memorialists "are of opinion that this country has been slow, as compared with some other nations, in recognising how greatly education increases national strength when it permeates every class of the community and makes for the unity of the nation. They, therefore, urge that adequate provision for education in all grades, from the primary school to the university, be made in every defined area of the population; that the artificial barriers between grade and grade should be, so far as possible, broken down, and facilities given to every child, whatever his birth or creed, to proceed unhindered to his appropriate development and towards a national ideal of intellectual, spiritual, and vocational efficiency." The petition urges the Government to undertake forthwith "a comprehensive reform of the national education, making for the good of the nation as a whole.

THE Admiralty has issued a circular detailing the steps it is proposed to take to supplement the supply of officers for the Navy. The new requirements of the Air and Submarine Services, the establishment of the Dominion Navies, and other causes all make an increased number of naval officers necessary. This greatly augmented demand will be met in part by promotions from the lower deck, by absorption of officers from the R.N.R., and in other ways, but to provide officers available for service in 1920 a new policy is to be adopted in addition to existing plans. The special entry is proposed of a limited number of cadets of about the age of eighteen, who have completed their general education. A number of such cadets not exceeding thirty annually will be admitted by competitive examination of selected candidates. They will be sent to a naval establishment for a course of professional training before being distributed as midshipmen in the fleet. The same subsequent career will be open to them as to officers who have entered through Osborne. They will be free to volunteer for service in any one of the special branches. The entrance examination will be such as to attract candidates who have received at school a good grounding in mathematics, mechanics, and physics. The subjects of examination will be nearly identical with those prescribed for entry to Woolwich, but some weight will be assigned to an elementary knowledge of engineering science in addition to the usual Woolwich subjects. The course of training which these cadets will undergo after admission will consist largely of instruction of a practical kind in naval engineering and in the service applications of electricity. The first special entry under these conditions will take place by competitive examination in June next. An Admiralty Committee will interview each candidate and examine credentials furnished by the headmaster of the school he is attending or last attended. On the report of this committee it will be determined whether the candidate shall be admitted to compete.

DURING the International Kinematograph Exhibition, to be held at Olympia on March 22–29, there will be an educational conference, at which the use and value of the kinematograph as an aid to instruction will be discussed. It would, of course, be absurd to suggest that direct observation, or mental work requiring the individual activity of the pupil, can be replaced as educational factors by the more or less passive contemplation of moving pictures; nevertheless, there are many subjects, which can be illustrated more effectively by the kinematograph than by any other means. Moving pictures representing the peoples, industries, and characteristics of many lands give more accurate impressions than many pages of a geographical reading book; the dry bones of history may be made to live in the minds of pupils by means of some of the historical films available; animals may be seen in their natural haunts; the stages of development of an animal or plant can be followed in quick and orderly sequence; the nature of disease and the value of preventive medicine can be illustrated; and many other points not easily explained can be presented in the most striking manner. At the forthcoming conference the application of the kinematograph to instruction in various branches of the curriculum, and to education generally, will be discussed. Among the speakers will be Dr. Lyttelton (headmaster of Eton), Mr. Stephen Paget, Miss Von Wyss (president of the Nature Study Union), Dr. Walmsley, Mr. F. W. Sanderson (headmaster of Oundle School), Mr. A. P. Graves (late H.M. Chief Inspector of Schools). Messrs. Pathé Freres will show many of their educational films during the conference in illustration of the various subjects brought forward. The

kinematograph may be made such an effective educational instrument that encouragement should be given to all who are endeavouring to discover its best uses and to produce pictures above the penny-dreadful type which is now too common.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 6.—Sir Alfred Kempe, vice-president and treasurer, in the chair.—Prof. J. C. **Bose**: An automatic method for the investigation of the velocity of transmission of excitation in Mimosa. The research was undertaken to decide the question whether in *Mimosa pudica* stimulus gives rise to a mere passage of hydro-mechanical disturbance or a transmission of true excitation. The results obtained warrant the conclusion that there is transmission of true excitation.—W. K. **Spencer**: The Evolution of the Cretaceous Asteroidea. An endeavour is made to trace the evolution of the starfish through the whole of the Cretaceous deposits. At the first sight the material appeared to be unpromising, for complete or even fragmentary specimens are rare. It has been found possible, however, to use the isolated marginal plates which are found fairly commonly on weathered chalk surfaces. It is shown that these marginal plates have a shape and ornament characteristic of each distinct species. The species may be arranged in lineages, and the examination of large collections made by English and Continental workers make it feasible to trace the life-history of most of the lineages.—Dr. E. A. Newell **Arber**: A preliminary note on the fossil plants of the Mount Potts Beds, New Zealand, collected by Mr. D. G. Lillie, biologist to Capt. Scott's Antarctic Expedition in the *Terra Nova*, in 1911. The communication briefly discusses the first results, which have reached this country, of the late Capt. Scott's second Antarctic Expedition. In the winter months of the last two years the *Terra Nova* has been at work in New Zealand waters. During these periods Mr. D. G. Lillie, one of the biologists of the expedition who has been attached throughout to the *Terra Nova*, has been endeavouring to clear up on the evidence of the fossil floras some of the many points which remain unsolved with regard to the stratigraphical geology of New Zealand. In particular, he has made large collections from the Mount Potts Beds, in Ashburton County, Canterbury. Whether these beds contain Glossopteris, as asserted by Hector and others, has long been a matter of dispute, for the whole question whether New Zealand formed part of the great southern Permo-Carboniferous continent of "Gondwanaland" depends entirely on the character and age of the flora of these beds. As it proves, the flora of these beds is thoroughly Mesozoic. The flora as a whole consists chiefly of Rhætic plants, though a few Jurassic types also occur, and thus the age of the beds is either Rhætic or Lower Jurassic. The Mount Potts beds are admittedly the oldest plant-bearing series, in a geological sense, as yet discovered in New Zealand. No Palæozoic plants are known from these islands, and there is thus no evidence that they formed part of "Gondwanaland" in Permo-Carboniferous times.—Sir D. **Bruce**, Majors D. **Harvey** and A. E. **Hamerton**, Dr. J. B. **Davey**, and Lady **Bruce**: (1) Trypanosomes found in the blood of wild animals living in the sleeping sickness area, Nyasaland. (2) Trypanosome diseases of domestic animals in Nyasaland. II., *Trypanosoma Caprae* (Kleine). (3) Morphology of various strains of the trypanosome causing disease in man in Nyasaland. I., The human strain.

Linnean Society, February 20.—Prof. E. B. Poulton, F.R.S. president, in the chair.—Roland H. **Deakin**: Anatomy of the larva of *Phryganea stricta*.—W. Botting **Hemsley**: The genera Radamæa, Benth., and Nesogenes, A. DC. *Radamaea montana* is a shrub from Madagascar, and some imperfect specimens of a similar plant were referred to his *R. prostrata*. On comparing these specimens with some collected on the *Sealark* expedition by Prof. J. Stanley Gardiner and Mr. J. C. F. Fryer, the author found it had to be transferred to its proper genus, Nesogenes. Four species of the latter genus are now known, including a new one from Aldabra, named *N. Dupontii*, Hemsl., after the discoverer.—Prof. R. J. Harvey **Gibson** and Margaret **Knight**: Marine Algæ collected by Mr. Cyril Crossland in the Red Sea. Part ii. was mainly a list of species, forty-six in number, thirty-five of which are additions to the former list. The authors have observed sexual and asexual organs, not merely on the same plant, but on the same branch, in several species, and consider the phenomenon to be by no means exceptional.

BOOKS RECEIVED.

Problems of Life and Reproduction. By Prof. M. Hartog. Pp. xx+362. (London: J. Murray.) 7s. 6d. net.

Geschichte der deutschen Naturphilosophie. By Dr. C. Siegel. Pp. xv+390. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 10 marks.

A Foundation Course in Chemistry for Students of Agriculture and Technology. By J. W. Dodgson and J. A. Murray. Pp. x+244. (London: Longmans and Co.) 3s. 6d. net.

An Introduction to Metaphysics. By Prof. H. Bergson. Authorised translation by T. E. Hulme. Pp. vi+79. (London: Macmillan and Co., Ltd.) 2s. net.

The Development of Mathematics in China and Japan. By Y. Mikami. Pp. x+347. (Leipzig: B. G. Teubner; London: Williams and Norgate.) 18 marks.

The Elements of Heating and Ventilation. By Prof. A. M. Greene, jun. Pp. vi+324. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 10s. 6d. net.

Vertebrate Embryology. By Dr. J. W. Jenkinson. Pp. 267. (Oxford: Clarendon Press.) 12s. 6d. net.

Development and Purpose: an Essay towards a Philosophy of Evolution. By Prof. L. T. Hobhouse. Pp. xxix+383. (London: Macmillan and Co., Ltd.) 10s. net.

Aristarchus of Samos. The Ancient Copernicus. A History of Greek Astronomy to Aristarchus, together with Aristarchus's Treatise on the Sizes and Distances of the Sun and Moon. A New Greek Text, with Translation and Notes. By Sir T. Heath. Pp. viii+425. (Oxford: Clarendon Press.) 18s. net.

Materialien für eine wissenschaftliche Biographie von Gauss. By F. Klien and M. Brendel. Heft 2/3. Pp. 143. (Leipzig: B. G. Teubner.) 4.40 marks.

Report of the Thirteenth Meeting of the Australasian Association for the Advancement of Science, held at Sydney, 1911. Pp xciii+766+48 plates. (Sydney.)

Chloride of Lime in Sanitation. By A. H. Hooker. Pp. v+231. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.)

The Trades School in the Transvaal. By W. J. Horne. Pp. viii+96. (Johannesburg: Argus Printing and Publishing Co., Ltd.)

Union of South Africa. Department of Agriculture. Report with Appendices for the period May

31, 1910, to December 31, 1911. Pp. iv+663+plates. (Cape Town: *Cape Times*, Ltd.)

L.M.B.C. Memoirs of Typical British Marine Plants and Animals. xxi., Eupaguans. By Dr. G. Jackson. Pp. viii+79+vi plates. (London: Williams and Norgate.) 2*s.* 6*d.*

Philips's Panama Canal Route Globe. (London: G. Philip and Son, Ltd.) 2*s.* 6*d.* net.

The Economics of Everyday Life: a First Book of Economic Study. Part i. By T. H. Penson. Pp. xiv+174. (Cambridge University Press.) 3*s.* net.

The Manufacture of Sulphuric Acid and Alkali with the Collateral Branches. By Prof. G. Lunge. Fourth edition. Vol. i., part i. Pp. xxiv+582. Part ii. Pp. xii+583–1078. Part iii. Pp. xii+1079–1617. (London: Gurney and Jackson.) 3*l.* 3*s.* net.

Verhandlungen des Naturhistorischen Vereins der preussischen Rheinlande und Westfalens. Neunundsechzigster Jahrgang, 1912. Erste Hälfte. Pp. lv+223+plates. (Bonn: F. Cohen.)

Technical School Organisation and Teaching. By C. Hamilton. Pp. xii+178. (London: G. Routledge and Sons, Ltd.) 2*s.* 6*d.* net.

Anleitung zur Kultur der Mikroorganismen. By Dr. E. Küster. Zweite Auflage. Pp. v+218. (Leipzig and Berlin: B. G. Teubner.) 8 marks.

The Organometallic Compounds of Zinc and Magnesium. By Dr. H. Wren. Pp. viii+100. (Chemical Monographs.) (London: Gurney and Jackson.) 1*s.* 6*d.* net.

La Télégraphie et la Téléphonie Simultanées et la Téléphonie Multiple. By K. Berger. Pp. 134. (Paris: Gauthier-Villars.) 4.50 francs.

Les Appareils D'Intégration. By H. de Morin. Pp. 208. (Paris: Gauthier-Villars.) 5 francs.

Aus Natur und Geisteswelt. Band 393, Die Dampfmaschine. By Prof. R. Vater. Dritte Auflage. Pp. vi+104. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

First-Year Course in General Science. By E. A. Gardiner. Pp. vi+113. (London: W. Heinemann.) 2*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 13.

ROYAL SOCIETY, at 4.30.—A Simple Method of Finding the Approximate Period of Stable Systems: A. Mallock.—The Motion of Electrons in Gases: Prof. J. S. Townsend and H. T. Tizard.—The Self Inductance of Circular Coils of Rectangular Section: Prof. T. R. Lyle.—Ammonium Ferrous Sulphate and its Alkali-Metal Isomorphs: Dr. A. E. H. Tutton.—The Recombination of the Ions produced by Röntgen Rays in Gases and Vapours: H. Thirkill.—Optical Investigation of Solidified Gases. III. The Crystal-properties of Chlorine and Bromide: Dr. W. Wahl.

ROYAL INSTITUTION, at 3.—Surface Energy: W. B. Hardy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Power Supply on the Rand: A. E. Hadley.

CONCRETE INSTITUTE, at 7.30.—The Strength of Cement: H. C. Johnson.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual General Meeting.

MATHEMATICAL SOCIETY, at 8.—Some Cases of Tidal Motion of Rotating Sheets of Water: J. Proudman.—Indeterminate Equations of the Third and Fourth Degree: L. J. Mordell.

SOCIETY OF DYERS AND COLOURISTS, at 8.—Stripping Agents for Garment Dyers: F. G. Newbury.—A Few Notes on Fur Dyeing: M. C. Lamb.

FRIDAY, MARCH 14.

ROYAL INSTITUTION, at 9.—Great Advance in Crystallography: Dr. A. E. H. Tutton.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Some Effects of Superheating and Feed-water Heating on Locomotive Working: F. H. Trevithick and P. J. Cowan.

PHYSICAL SOCIETY (University College, Gower Street), at 5.—Demonstration of Spark Photographs: W. B. Haines.—(1) Some Oscillograms of Condenser Discharges and a Simple Theory of Coupled Circuits; (2) Exhibition of Braun Kathode-Ray Tubes and an Electrostatic Machine for Working them, used as a High-frequency Oscillograph: Prof. J. A. Fleming.—The Stretching and Breaking of Sodium and Potassium: B. B. Baker.—The Latent Heat of Evaporation of Aqueous Salt Solutions: R. G. Lunnon.—Some Flame Spectra: Dr. E. N. da C. Andrade.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Sounds Alleged to Accompany Flights of Meteors: A. King.—Note on the Possibility of Refraction by the Sun's Atmosphere. Papers of the I.U.S.R. No. VIII.: R. S. Capon.—Observations of Gale's Comet: Sydney Observatory.—A Family of Oscillating Orbits of Short Period; H. R. Willard.—Note on the Nebula H I Cassiopeiæ: Mrs. Isaac Roberts.—Notes on Fireballs and Shooting Stars: W. F. Denning.—The Variable Star R Cygni: E. E. Barnard.—A Formula for Correcting Statistics for the Effects of a Known Probable Error of Observation: A. S. Eddington.—*Probable Papers*: Observations made with the Durham Almucantar during 1912: E. H. Hills and F. C. H. Carpenter.—Enhanced Lines in the Early Spectrum of Nova Geminorum No. 2: H. F. Newall and F. J. M. Stratton.—The Distribution in Space of the Stars of Carrington's Circumpolar Catalogue: F. W. Dyson.—The Distribution in Space of the Bright Stars: A. S. Eddington.—Report on the Expedition to Passa Quatro, Brazil, to observe the Total Solar Eclipse of 1912 (October 10): A. S. Eddington and C. Davidson.

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ROYAL INSTITUTION, at 3.—The Properties and Constitution of the Atom: Sir J. J. Thomson, O.M.

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VICTORIA INSTITUTE, at 4.30.—The Bearing of Archæological and Historical Research on the New Testament: Rev. Parke P. Flournoy.

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INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Notes on City Passenger-Transportation in the United States: G. D. Snyder.

WEDNESDAY, MARCH 19.

ENTOMOLOGICAL SOCIETY, at 8.—The Classification of the British Crabronidæ (Hymenoptera): Dr. R. C. L. Perkins.

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THURSDAY, MARCH 20, 1913.

COLOUR VISION.

Researches in Colour Vision and the Trichromatic Theory. By Sir William de W. Abney, K.C.B., F.R.S. Pp. xi+418+5 plates. (London: Longmans, Green and Co., 1913.) Price 21*s.* net.

THERE is certainly no living authority on "colour-vision" more competent to throw light on that intricate and perplexing subject than the author of this work. Sir William Abney has attacked the various problems which present themselves by his own methods and with the utmost completeness of detail. In almost every conceivable way he has tried to correlate the more precise physical facts, elicited by carefully and ingeniously modified experiments, with the vaguer physiological conceptions arrived at from a study of normal and abnormal sensations of colour. The present work embodies and collects into a consecutive whole a record of the author's previously published researches. The book is consequently one which will be regarded as a standard work. It gives the most complete and clear exposition of the trichromatic theory of Young-Helmholtz. It will, we venture to think, be more readily understood than Helmholtz's own latest treatment of the subject as given in the last edition of his "Physiological Optics."

So far as Sir William Abney's researches go, it must be admitted that they afford strong evidence of the fitness of the trichromatic theory to explain how normal colour sensations may be evoked by the known physical causes. The difficulty comes in attempting to explain congenital and acquired defects in colour-sensation in accordance with that theory. To do so by inferring that there is then a complete absence of stimulability, or a weakening in the stimulability, of one of the three end-organs supposed to correspond to a so-called "fundamental. sensation," leads to hypothetical conclusions as to the way in which colours are perceived by the colour-blind. The many interesting experiments adduced by the author in support of the idea of altered stimulability of the end-organs in the colour-blind can scarcely be said to be convincing. It may indeed be asked: Why should abnormal colour "sensation" depend at all upon abnormal "stimulability"? There are different stages in the production of colour sensations in response to objective stimuli. These are: the effect of the physical cause on the percipient elements of the retina, the conduction by the optic nerve, and, lastly, the response in the brain-cells. Might not an abnormality in the last stage, the final "response," be consistent with colour confusion complete and incomplete, altogether independent of any abnormality in the colour end-organs of the retina? In cases of acquired colour-blindness there is, in fact, good reason to refer the defect both to altered conductivity in the optic nerve-fibres and to changes in the central cells.

From the way in which colours are matched by the "colour-blind" it is difficult, apart from theory, to believe that the colour-blind spectrum is, such as would appear to the normal eye anything remotely comparable to that represented for a "red-blind" and a "green-blind" individual respectively in plate i. Even admitting that there is an appreciable difference between the two classes of cases, which are thus classified in accordance with theory, it is almost inconceivable that the spectrum can appear so different in the two cases.

Some colour-blind people, it is true, are unconscious or only vaguely suspicious of their condition. But there are others who are well aware of it. Some are even keenly interested in analysing their colour-impressions and in comparing them with those of normal individuals. The writer of this notice has met with several who have done so. Without exception and without regard as to whether they might be classified as "red colour-blind" or as "green colour-blind," they have arrived at the conclusion that their yellow and blue sensations are not materially different from the normal. Their absolutely dichromatic spectrum consists of a "warm" and a "cold" colour sensation, which, when saturated, as compared with other colours to them, are often described as 'vivid" and "pleasurable."

In a letter received in 1879 from Dr. William Pole, who was "colour-blind" and well known for his own contributions to this subject, he states:—"I am more than ever convinced of the enormous difficulty normal-eyed persons find in understanding what we, the colour-blind, really see." Again, in 1890, referring to Clerk Maxwell, he says:—"He examined me carefully with spectral apparatus, but he spoilt all his results by insisting that my warm colour must be the Young-Helmholtz fundamental 'green,' and as I obstinately refused to adhere to what seemed to me a preposterous contradiction of all my experience, he never published his trials. . . . Now the general opinion seems to agree with my own impression that it is yellow, *i.e.* no Young-Helmholtz fundamental at all."

Again there is surely no proof that the colour-blind see white otherwise than the normal-eyed. No difference in a white object can be seen as it is passed from the periphery of the field of vision

to the centre. Yet there is a colour-blindness of the normal peripheral field which is analogous to, though possibly not identical with, congenital colour-blindness. One of the assumptions, however, which is made, in the endeavour to make the theory suit the case of colour-blindness, is that the colour-blind "white" is altogether different from the normal-eyed "white." According to Sir William Abney, the "white" of the "red-blind" is a sea-green, and that of the "green-blind" a brilliant purple. But it would appear from the nature of the actual experiments on which this assumption is based (pp. 273, 274) that there is here only a confusion between the sensations to which these colours give rise in normal eyes and the *neutral* sensations which they evoke in the colour-blind.

In every case of complete colour-blindness (which causes colour-confusion only and is distinguished, therefore, from total loss of any colour perception) there are two hues which, though most definite and vivid to the normal-eyed, appear altogether uncoloured or neutral. Only one of these neutrals is to be found in the spectrum, though both can be produced by combinations of spectral colours. This is obviously something different from a demonstration of the manner in which what to the normal eye is white is seen by the colour-blind. But it may be asked: Is there any reason for entirely giving up the trichromatic theory because it does not meet with general acceptance when "doctored" to suit the case of colour-blindness? A study of Sir William Abney's work must convince one how strongly it is supported by physical facts.

A quotation from the preface may fittingly conclude a necessarily too short notice of this valuable and comprehensive work. The author there makes the following suggestive remark:—

"A theory, to be one of perfection, must offer the truth, the whole truth, and nothing but the truth. The trichromatic theory offers the truth; but the physiologists must add their quota to make it the whole truth. There may be difficulties in welding together the physical and physiological aspects of colour vision to make a perfect theory, but it will be effected."

A MEDIEVAL PHYSICIAN.

John of Gaddesden and the Rosa Medicinae. By H. P. Cholmeley. Pp. 184. (Oxford: Clarendon Press, 1912.) Price 8*s*. 6*d*. net.

OLD books, at any rate old medical books, may, as regards their contents, be divided into three classes: those intrinsically valuable as sources of more or less original knowledge—of such are the Hippocratic writings, Galen, Alexander of Tralles, some of the Salernitan treatises, the greater medieval Italian and French surgeons, Sydenham, Morgagni—names taken at hazard; secondly, those which, although not original sources, yet enshrine more or less admirably the works of great men or of schools which had otherwise perished—of such are Celsus, our chief resource for the doctrines of Alexandrian medicine, or Cælius Aurelianus, which preserves for us some of the writings of Soranus, or Aretæus, or Oribasius—names again chosen at random, or smaller books which also, as rafts or broken pieces of the ship, may salve lesser fragments of ancient lore—books such as Aetius or Paul of Ægina; and, thirdly, old books which have no other value than the bibliophile may, in the fashion of the time, choose to confer upon them as antiques. These books, for their quaintness, may arouse some interest, and of such is the book before us.

John of Gaddesden's book may in its time have served as a handy "Practica" for his contemporaries, but in later centuries probably the best use it has served is as a nucleus around which Dr. Cholmeley has gathered much interesting historical matter, very aptly and pleasantly put together. The original John is poor stuff. His editor respectfully offers to him some tribute, asking us to recognise at least his clinical insight. John, who died in 1361, highly educated at Oxford and in later life a fashionable Court physician, enjoyed great advantages of experience, and no doubt brought these advantages to the construing of his Oxford "Theoretica" and "Practica"; but his own contributions were exiguous. Arderne, if no great author, was at any rate superior to John of Gaddesden, and we hope that the success of this edition may tempt Dr. Cholmeley to follow up Mr. D'Arcy Power's pioneer work with a like volume on Arderne.

In studying the writings of early physicians we must continually remember that literary ethics was not born until modern times—almost in our own day. It is scarcely fair to these old men, when they lifted pages upon pages from their forerunners, to accuse them of "shameful plagiary." They all did it, and not in medicine only; and not only the inferior authors, but the most reverend of them also. So John, with a pious obsequiousness, helped himself to what he could find elsewhere to serve his purpose. As a specimen of John's wonderfully vivid clinical pictures, Dr. Cholmeley quotes his description of obstructive jaundice with ascites. It is vivid, no doubt; but we may be sure that it is not John's. To track out the sources of all or many of his purple patches would be a long business, but in respect

of this passage, as Avicenna lay near me, I looked up this subject therein; I did not find there this paragraph as a whole, it is true, but I found every or almost every sentence of it in Avicenna (Lib. iii., Fen 14, Tr. 4), sentences condensed either by John himself or by someone whom John copied. And thus, with a little trouble, I suspect we might run to earth most or all of John of Gaddesden's clinical equipment. I turned to Avicenna remembering that Razes diagnosed ascites by fluctuation and percussion.

It is not quite easy to account for the sterility of Great Britain in medicine, as in much other knowledge, during the fourteenth and early fifteenth centuries. Gaddesden's book must have been written before the Black Death. Edward the Third was an accomplished sovereign, and England was not more harried by wars than France, yet we have nothing distinguished to show before the time when began the great procession of Gilbert, Clowes the elder, Harvey, Glisson, Wharton, Willis, Lower, Wiseman, Mayow, to prove that Englishmen were capable of carrying the banner of medicine as high as their neighbours. Before the revival it is true that England was somewhat isolated from the main streams of European learning. Anyhow, the history of medicine in England before the accession of the Tudors is a dreary study.

We know how well equipped in the fourteenth century Merton was, or ought to have been, in this field; and Gaddesden was of Merton. Perhaps no faculty has been so robbed of its endowments as medicine; witness also the Linacre trusts and the Gresham College; moreover, of the three "philosophies," the natural branch was gradually eliminated. It is interesting to learn, however, from Dr. Cholmeley that John was a graduate in medicine. I am not sure if Dr. Cholmeley has any higher authority for this title than Wood, to whom he refers. In Cambridge we have little record, if any, of actual M.D.'s before the sixteenth century; and the early statutes, which may be cited as evidence of study for the degree, are (as in Peacock) of uncertain date. Of course, it is probable that in both universities physicians then graduated as M.D.; but are the graduations on record? The "clerks" who studied medicine, at any rate if in orders, seem not to have taken the title of M.D. I ask this as Dr. Cholmeley has added to this book a very interesting narrative of medical education in Oxford. With a true intelligence he has done what was possible to trace the titles of books on medicine then in the University; for in the Middle Ages books were as much the cause of a university as teachers. The author says that Montpellier at that time outshone Oxford as a medical school; the reason, or one reason, is that the libraries of Montpellier were fed from Cordova. Thus also Frederick the Second wisely commended his foundation at Naples by purchasing books for large sums from the Grand Trunk.

Dr. Cholmeley has another interesting chapter on the medieval physician, and others on kindred subjects, for which we thank him cordially. We wish Dr. Cholmeley health and leisure to extend his gifts to us of like scholarly volumes on other chapters of the history of medicine.

CLIFFORD ALLBUTT.

THE STRUCTURE AND BIOLOGY OF THE BACTERIA.

(1) *Die Zelle der Bakterien.* Für Botaniker, Zoologen und Bakteriologen. By Prof. Arthur Meyer. Pp. vi+285+plates. (Jena: Gustav Fischer, 1912.) Price 12 marks.

(2) *Bau und Leben der Bakterien.* By Prof. W. Benecke. Pp. xii+650. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 15 marks.

THESE two works are evidence, if any be needed, of the increasing interest which is being evinced in the study of the bacteria by biologists. The literature concerning them has now become so extensive that summaries such as are contained in these two volumes are very welcome.

(1) The first book treats almost exclusively of the structure and elements of the cells of the micro-organisms classed by Migula under the Eubacteria. The cells of most of these organisms are so minute that it is only by the employment of the most refined methods of research that their intimate structure and the nature of their cell-contents can be elucidated. The introductory portion deals with the classification of these organisms and with their affinities with other unicellular vegetable forms and with the Protozoa. The author considers that the Eubacteria are closely related to the Hemiascomycetes and Euascomycetes of the fungi. Successive sections deal with the structure and elements of bacterial cells—nucleus, plasmodia, cytoplasm, flagella, membrane, vacuoli, and reserve material. In each section the work of various investigators on the subject is summarised and criticised with commendable completeness. In a final section the question of the chromophyllous nature of the colouring matter of the "purple" bacteria is discussed.

For the specialist who requires a general summary of what is known respecting bacterial structure, no better book could be found. It is pro-

fusely illustrated in the text, and contains one coloured plate showing the elements and structures brought to light by the application of various methods, staining agents and other reagents. A full bibliography is appended, but an index is lacking, which is a great mistake.

(2) The second volume is one more adapted to the needs of the biologist or of the general reader, inasmuch as it gives a general survey of the structure and functions of the bacteria and of their activities. The first two chapters are devoted to a consideration of the size, form, development, and occurrence of the bacteria and to the methods employed in studying and cultivating them. Chapters iii.–vi. deal with their morphology and the structure of the bacterial cell. As regards classification (chapter vii.), the author divides bacterial organisms into two suborders, the Haplobacterinæ and the Desmobacterinæ, the former including the single-celled bacteria, the latter the thread-forming organisms such as Leptothrix, Crenothrix, Cladothrix, and Beggiatoa. As an appendage of the Haplobacterinæ he recognises the Mycobacteriaceæ ("Pilzbakterien"), in which he places such organisms as the tubercle bacillus and Actinomyces, and the Myxobacteriaceæ or "slime bacteria." Truly the classification of the bacteria is still in a very unsatisfactory condition!

Variation and mutability among the bacteria are discussed at some length, after which the conditions of life and general physiology of the bacteria are dealt with: assimilation and dissimilation, fermentation, nitrogen fixation, &c. Finally, the occurrence and distribution of bacteria on the earth's surface, in arable, grass, and wooded lands, in water and dwellings, are considered. The book is exceedingly well conceived, and contains a mass of trustworthy information with sufficient references to the literature. It is well printed and illustrated, and is supplied with adequate indexes to the matter it contains and to the authors mentioned.

R. T. HEWLETT.

OUR BOOKSHELF.

Guide Scientifique du Géographe-Explorateur. By P. Crépin de Beauregard. Pp. x+250+2 plates. (Paris: Gauthier-Villars, 1912.) Price 10 francs.

THIS work is not intended for the ordinary traveller who wishes to prepare a sketch-map of the country which he traverses, and to determine with moderate accuracy the position of his halting places. M. Crépin de Beauregard, who has had much experience of surveying both in France and in Indo-China, has prepared a handbook for the trained surveyor who has a certain knowledge of mathematics and has to undertake work of considerable accuracy in new countries in order to provide a control for subsequent topographical surveys. The treatment is consequently in a large degree theoretical, though actual examples from work in the field are given, but the simpler and less precise methods of topographical surveying are not included.

The first chapter deals mainly with the trigonometrical formulæ involved, while in the second the theodolite is discussed as being the instrument employed, and the errors introduced by dislevelment, &c., are investigated. Coming to the astronomical determinations which the surveyor requires to make in the field, the most suitable methods of determining the local time, the latitude of a station, and the azimuth of a mark are fully discussed theoretically, and an example of each is worked out. In these cases each observation made is worked out separately and a mean value of the results is obtained, though the probable error is not considered.

In that part which treats of triangulation the author deals with the computations which are necessary in first and second order triangulation where the surface is treated as that of a spheroid, and in third order work where spherical formulæ suffice. Map projections occupy a chapter, and these are not limited to those types which are likely to be employed by those who are surveying a new country, but include all the principal types. The book should be of much use to those trained surveyors who are steadily extending the network of triangulation in Algeria and Tunis, in Indo-China and Madagascar.

H. G. L.

Introduction to the Rarer Elements. By Philip E. Browning. Pp. xii+232. Third edition. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1912.)

To this edition of Dr. Browning's book several additions have been introduced and numerous changes made. The chapter on qualitative analysis has been enlarged by the inclusion of new diagrams, new material has been added to the chapter on technical applications, and a table of spectroscopic lines and plates showing typical spectra have been introduced. The second edition was reviewed in NATURE of April 15, 1909 (vol. lxxx., p. 182).

A First Book of Electricity and Magnetism. By W. Perren Maycock. Fourth edition. Pp. xxii+351. (London: Whittaker and Co., 1913.) Price 2s. 6d. net.

THE first edition of Mr. Maycock's little book was reviewed in the issue of NATURE for January 14, 1892 (vol. xlv., p. 248). The present issue has been revised thoroughly and enlarged considerably, and the author has been successful in his desire to "carry the reader over the threshold of a subject whose theoretical and practical extents are very far-reaching."

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Radio-Elements and the Periodic Law.

I AM grateful to Prof. Schuster for the opportunity he has afforded by his letter (NATURE, March 13) for the discussion of the wide generalisations that have been made with regard to the position of the radio-elements in the periodic table, consequent on the recent experimental work of A. Fleck and of the theoretical suggestions of A. S. Russell and K. Fajans. The whole question is one in which it is important that there should not be any doubt as to the real nature of the evidence adduced. Prof. Schuster's criticism of my views on the subject could scarcely be more sympathetic or helpful, and can only result in a maturer outlook on this important question.

Granting for the sake of argument the possibility of the existence of groups of elements not necessarily of identical atomic mass, with identical chemical properties and spectra, the only known direct manner in which the existence of the members of these groups could be separately recognised is radio-active evidence, in which one member is formed from another, not directly, but through the intermediary of other elements, possessing, necessarily as now appears, completely different chemical properties. Hence it is natural that at first direct evidence should be confined practically to the subject of radio-activity, and much depends upon whether that evidence is considered real evidence approaching experimental proof, or whether it is regarded as merely negative in character.

In the first place, I admit when I wrote the expression, "non-separable by any known process," I had in mind chemical processes. It is unusual and illustrative of the peculiarities of the problem that the relatively rough and partial means of physical analysis, to which Prof. Schuster refers, may be expected ultimately to succeed where the most refined and delicate methods of chemical analysis may be expected to fail. But so it is, and I agree with Prof. Schuster that it should ultimately be possible partially to separate by purely physical methods certain members of these chemically identical groups by virtue of the slight differences in their molecular masses. In fact, a year ago I commenced an experiment to try to effect a partial separation of the two uraniums by diffusion in solution. This case is an exceptionally favourable one as an alteration in the relative concentration of the two uraniums by only a few per cent. should be detectable without any uncertainty by radio-active methods.

Although the term "non-separable" I think connotes present inability, without implying, necessarily, anything as regards what may be possible in the future, I do, however, think that there are good grounds for believing that the *chemical* non-separability of elements occupying the same place in the periodic table is due to the general character of chemical methods rather than the state of refinement and delicacy attained at any particular time. The chemical analysis of matter has given us the periodic law, and there is no case known of two or more ordinary elements with claims to the same place in the periodic table. In this connection the case of the rare-earth group of elements is necessarily excluded, as these elements certainly do not obey the law without modification. In all other parts of the table the rule is that there is only one element for each place, and each place signifies a separate chemical type differentiated in a regular manner from its neighbours. But now the radio-active series have shown that different elements, not necessarily of identical atomic mass, do occupy the same place, and that when this occurs these elements possess identical chemical nature. It is therefore an inference supported by the known facts of chemical analysis that the single place in the periodic classification represents the limits of the analysis of matter by chemical methods, rather than the ultimate analysis into homogeneous types, such as is usually implied in the conventional view of elements.

Prof. Schuster admits that the chemical properties of these non-separable groups of radio-elements are probably more nearly equal than those of the longer-known elements, but claims that there is a vast interval between "very similar" and "identical." I do not like the term "very similar." It is ambiguous, and may mean nothing more than that the experimental examination has been neither skilled nor exhaustive enough to disclose the differences, if any exist. Unless this is the case, I feel that the proper term to use is "identical." Otherwise the word "identical" ought to be expunged from scientific language altogether. Unless there is some reason to foresee a qualification being required by the further progress of knowledge, a definite statement ought to be preferred in science to an ambiguous one, which on account of its vagueness must necessarily remain true for all time. Scientific statements can only express present knowledge, including in this term reasonable inferences from the whole field of such knowledge.

The term "chemically identical" has not been applied until after an examination, not, of course, in every case, but in every possible case, and in sufficient numbers of cases to reveal the general law, as skilled and exhaustive as the present art of chemical analysis allows, and, what is equally of importance, by the use of methods for detecting changes in relative concentration as delicate as any that exist. The example quoted of praseodymium and neodymium ought to be more closely examined. These elements proved to be separable as soon as optical methods of revealing their separate existence became known. In the case of the radio-elements the separate radio-active nature of each individual of the group is exactly known, the proportion of each in any mixture can be quantitatively evaluated. Yet they are non-separable. That some mixture to-day may still be classed as a homogeneous element because no means exist for the separate identification of its components does not affect the fact that some mixtures of elements capable of separate identification are chemically non-separable.

Difficulties of chemical analysis are often not connected with the methods of separation at all, but with the means of determining whether or not a separation has been effected, which, in the case of the difficult rare-earth group are relatively crude and sometimes misleading.

The suggestion, that in the disintegration process a mass equal to that of the α particle previously lost may be picked up, is not a probable one, but even if it is admitted, and it is supposed that parent and product have the same mass, it does not affect the view that they are two absolutely distinct types of matter, disintegrating at different speeds and in certain cases with expulsion of different kinds of rays. The attempt to meet this by supposing that the particular instability which determines their future may depend on their past is equivalent to admitting the

essential difference between the two types. Besides it can be stated definitely that for any one kind of instability, or for any one radio-active change, the past exercises absolutely no influence upon the events of the future. The period of average life of an atom depends neither upon how long it has already been in existence nor upon any other known condition. It is independent of concentration or the environment in which the atom disintegrates. These features of radio-active change are against the view that anything of the nature of atomic synthesis is going on concurrently with the disintegration, or that disintegration is conditioned by the drain of energy from the atom by radiation, as is so often affirmed.

The mass of evidence that has been accumulated that different elements have identical chemical nature is not accurately described as purely negative in character. The statement that A is non-separable from B is negative in form only. It contains explicitly an infinite number of definite positive statements that A is separable from C or D, or any other of the hundred or more known elements, or any conceivable mixture of them, by chemical methods, which are exactly indicated by the statement. It is not necessary that A and B should in every case coexist, though in certain cases—the two uraniums is a good example—they have never been obtained apart. Mesothorium-II. ordinarily occurs free from actinium, and the putting in of the latter substance is a voluntary experimental device to show that once mixed these two elements are chemically non-separable. The complete chemical nature of either, or of any other of the radio-elements, could be described in detail *ab initio*, but the negative form is brief and complete.

I do not think there are weaknesses in this part of the argument. It has been a slowly growing theoretical development, and I do claim for it something approaching experimental proof.

As regards the view that chemically identical groups of elements have the same spectrum, this admittedly I put forward on a single case, that of ionium and thorium. It rests entirely on the validity and generality of the α and β ray change rules, but, if these are true, ionium must be the direct product of uranium-II.; its period cannot be less than 100,000 years, and its proportion in the preparations spectroscopically examined less than 16 per cent. and 10 per cent. respectively. Any other view requires the assumption that one or more α ray and twice as many β ray changes remain to be discovered in the series, and it can be stated with some certainty that no such changes remain unknown.

Frankly, I do not expect Prof. Schuster or anyone else to accept a view of this kind, put forward on a single thread of evidence. The value of the view is merely that it suggests definite new lines of work, difficult and costly, but still experimentally feasible.

Prof. Schuster points out that the members of the thallium group, for example, ought to give the thallium spectrum in absence of thallium in the material. The latter condition is easy to ensure. But the case is not a very favourable one on the radio-active side, as thorium-D, the best example of the group to select, has a period of average life of only 4·5 minutes. The case, however, might be within the resources of some radium institute.

Since Prof. Schuster made this suggestion, I have gone into the experimental feasibility of getting evidence of this kind, and have decided to concentrate on the case of thorium-X, the spectrum of which should be identical with that of radium. It is a particularly crucial case. The spectrum reaction of radium is excessively delicate, and the amount of this element can be easily evaluated in quantities thousands of times less than can be spectroscopically detected. The chemical work is complicated, but really exceptionally favourable and elegant.

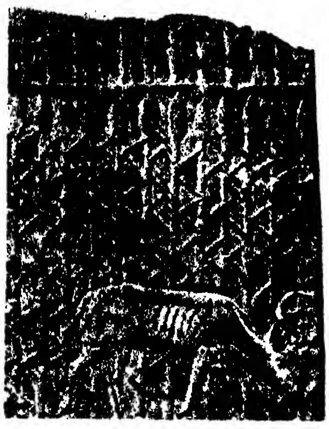
Mesothorium-I. is non-separable from radium, and radiothorium from ionium, the parent of radium, so that if radiothorium is grown from ionium-free mesothorium it can be purified from radium to any extent and left to produce thorium-X. Naturally, however, the work will require some years, but it should be within the resources of the individual investigator. At the same time, it will be possible to try during the course of the work a large number of similar cases, if a sufficient supply of the primary material, mesothorium-I. can be obtained. This inference as to the spectra is purely a personal view, and is to be taken merely as a suggestion until further evidence is forthcoming. But I would not have made it if I thought it inconsistent with any known evidence.

FREDERICK SODDY.

Physical Chemical Laboratory, Glasgow University, March 15.

An Unknown Assyrian Antelope.

My attention has been directed by the Rev. A. Paterson to a plate in a portfolio of photographs from Assyrian bas-reliefs published at Haarlem, but now out of print. This plate represents a bas-relief in the great hall of Sinnacherib's palace at Nineveh, and consists of an upper and a lower portion. The latter depicts the monarch in his chariot, while the upper shows a reed swamp with wild animals. This swamp is believed to be part of a pleasure-ground made by Sinnacherib in the neighbourhood of the palace, into which wild animals were turned. It is divided in the bas-relief into an upper and a lower portion. In the left-hand corner of the lower half is shown a wild sow with a litter of young, as they might appear at the present day in the reed-brakes of the Euphrates. The other animals are three ruminants, about half as big again as the sow, but with longer legs. The two in the upper half of the scene — of which one is lying down—are hornless, and therefore females, but the third, in the right-hand corner of the lower half, carries spirally twisted horns, recalling those of the African kudu, nyala, and situtunga, although not corresponding exactly in curvature with any of them. The tail is relatively short, as in the nyala. The buck is represented with its head down, nibbling the stem of a reed; on its body, in addition to parallel lines representing the ribs, are certain patches, which may be intended for broken pieces of reeds. These animals have been regarded as deer, but the buck carries horns, and not antlers, and antlered deer are not inhabitants of reed-brakes. On the other hand, such situations are the resort of several African antelopes, notably the situtunga, and it therefore seems prac-



The male antelope in the bas-relief of Sinnacherib's Swamp at Nineveh.

tically certain that the ruminants represented in the sculpture are antelopes. They must, moreover, be antelopes of an African type, as there are no marsh-haunting species with spiral horns known from Syria, or Asia in general, and the presumption is that they represent an extinct member of the tragelaphine group allied to the nyala and situtunga, in which the females are hornless. The tragelaphine group is represented at the present day in India by the nilgai and chousingha, in which the horns of the bucks are small, but there is evidence that in the Pliocene India was the home of species akin to the kudu and bush-buck. And it is therefore quite reasonable to expect that in Assyrian times a member of the group may have inhabited the Euphrates Valley.

R. LYDEKKER.

Cavities in Stones.

IN the description of the Agglestone "on the old moor of Studland, near the north shore of the Island of Purbeck," given in Warne's "Ancient Dorset," allusion is made to superficial cavities or hollows in this stone, and in stones in Yorkshire and Lancashire. In some cases "the cavities consist of holes about an inch and a half broad and of the same depth drilled into the stone." Mitchell[1] gives illustrations of the stones with cup-shaped markings described by Sir James Simpson in his work on "Archaic Sculptures."

In all probability these examples of supposed archaic sculptures (and others) have long ago received the "more extended investigation by competent observers" that Warne thought they deserved. But it would be of interest to know if they have been examined by conchologists as well as archæologists. There is just a possibility that some may be burrows excavated by *Helix aspersa*, for the description and illustrations recall the helicidean cavities in Carboniferous Limestone that occur somewhat frequently in Ireland, but are uncommon in Britain. The rock-shelters of *Helix aspersa* at Great Orme's Head, Llandudno, and at Miller's Dale, Derbyshire, have been fully described and illustrated,[2] also others more recently observed by myself in the limestone on Brean Down, Weston-super-Mare.[3]

E. W. SWANTON.

Sir Jonathan Hutchinson's Educational Museum, Haslemere, March 10.

An Experiment for Showing Lines of Force in an Electrostatic Field.

A GILT cork ball, about 1 cm. in diameter, is attached by sulphur to a vertical straw about 28 cm. in length. The lower end of the straw is fastened by sulphur to the centre of a circular cardboard tray about 5 cm. in diameter, in which is a ring of lead. The tray is put on a watch glass which floats on the surface of mercury in a large flat dish. (A developing dish about 30 cm. by 26 cm. was used, but a shallow wooden trough made for the purpose would be better.) In this way the gilt ball is able to move fairly freely in a horizontal plane. This float arrangement is kept in a bell-jar desiccator when not in use.

Two conducting spheres, about 10 cm. in diameter, are mounted on vertical glass tubes (sealed off at each end), and coated for about 10 cm. with sulphur, which can be readily got into a good insulating condition when required by warming in a flame. The centres of these spheres and the gilt ball are at the same level. The spheres being arranged on opposite sides of the dish, and so that the ball can touch them.

The spheres are connected either to the same terminal or to the opposite terminals of a Wimshurst machine.

The gilt ball describes curves which, when it moves slowly, give the general directions of the lines of force between the spheres in the plane it is free to move in.

The experiment is effective for illustrating lines of force in an electrostatic field and for leading up to the mathematical definition of potential. It may be extended for different charges on the spheres.

R. F. D'ARCY.

Caius College, Cambridge.

[1] "The Past in the Present," p. 86.

[2] John Taylor, "Monograph of the Land and Freshwater Mollusca of the British Isles," vol. i., p. 311, fig. 601, and vol. iii., pp. 244–246.

[3] E. W. Swanton, "The Mollusca of Somerset" (Somerset Arch. and Nat. Hist. Soc., 1912), pp. 26, 27, pl. iii.

Units of Pressure in Vacuum Work.

SURELY physicists do, or should, for convenience, always express wave-lengths in microns (μ) and molecular distances in millimicrons ($\mu\mu$). Why not follow the same practice in dealing with vacua? The millimetre is a convenient unit down to, say, 0·1 mm., but 1/1000 mm. and 1/10,000 mm. have frequently to be expressed. It is simpler to write and comprehend these in the form 1 μ or 0·1 μ. Again, in the pamphlet sent out by Dr. Gaede to describe his very successful pumps, we see unwieldy decimal expressions used. For instance, it is stated that it is possible to obtain a pressure of 0·000002 mm. of mercury after four minutes of pumping. Why not write this 2$\mu\mu$ of mercury?

There is a small unit sometimes found in researches, viz. one-millionth of an atmosphere, denoted by the letter M, but for this unit to have a definite numerical meaning it is necessary to quote the barometric reading at the time. If the barometric reading is normal 1 M=0·76 μ. But, of course, 0·76 μ alone needs no qualifying as to the barometric pressure, and therefore is simpler and more direct.

P. E. SHAW.

University College, Nottingham, March 2.

NEW MICROSCOPE EYEPIECES.

Eyepiece Micrometer.

DR. METZ, one of the researchers employed in the Leitz optical factory at Wetzlar, has recently described[1] a micrometer for use with the microscope which, if we are not mistaken, will rapidly replace all others, including the expensive filar micrometer where a mechanical stage is available. The root idea is that the scale used is such that microns can at once be read off without greatly changing the tube-length, or considering the micrometer value of the objective employed, and therefore dispensing with the arithmetic for which this is a necessary datum.

To bring this about, the intervals of the new scale, instead of being 1/10 or 1/20 mm. wide, as is usually the case in eyepiece micrometers, have a definite value of 0·06 mm.

With an objective of 2 mm ($\frac{1}{12}$) focus when a stage micrometer with ten $\frac{1}{100}$ mm. divisions is viewed, each of these divisions falls on the larger

[1] *Zeit. für wissenschaftliche Mikroskopie*, xxix., p. 72.

divisions of the eyepiece micrometer indicated by the steps (see Fig. 1). Each of the smaller divisions therefore represents a micron.

If exact coincidence between the eyepiece and stage scales does not occur with the proper tube-length, it should be varied a slight variation is all that is necessary—and the new tube-length recorded for micrometer purposes.

It is obvious that as a 4 mm. ($\frac{1}{6}$) objective has half the magnification of one with a focus of 2 mm., such an objective treated the same way will give us the ten divisions of the stage micrometer covering five of the large divisions of the eyepiece micrometer; hence to obtain microns we must multiply by 2, and this is all the arithmetic needed.

It also follows that with an 8 mm. ($\frac{1}{3}$) we must multiply by 4, and with a 16 mm. ($\frac{2}{3}$) by 8, to obtain the number of microns subtended by each of the smallest divisions of the eyepiece micrometer.

It will be seen then that one of the results of the new departure is to obtain for each objective and for a given tube-length convenient, and in the majority of cases integral, micrometer values, which greatly facilitate the use of the instrument. The actual tube-length differs in most cases but little from the standard length.

Dr. Metz in his paper gives the value of the unit of the scale and the proper tube-length to be used with each of the twenty-four of the achromatic, fluorite and apochromatic objectives produced by the Leitz firm.

FIG. 1.—Micrometer scale showing steps.

But, of course, the new micrometer can be used with any objective, and for general purposes it will be employed with objectives having foci of 2, 4, 8, or 16 mm. focus. These we have already considered.

The following table gives the tube-length results obtained in a trial of the new micrometer with objectives of different makers; it will also show the wonderful simplicity brought about:—

Focal length mm.	in.	Maker	Tube length for best definition	Tube length for scale coincidences	Scale divisions equivalent to $\frac{1}{10}$ mm.	Multiplier to obtain microns (μ)	One division of the scale $=\mu$
2	$\frac{1}{12}$	Crouch	170	170	100	1	1
,,	,,	Reichert (dry)	170	190			
,,	,,	Watson	200	*172			
4	$\frac{1}{6}$	Bausch & Lomb	160	188	50	2	2
,,	,,	Watson	200	210			
8	$\frac{1}{3}$	Winkel	170	*192	25	4	4
16	$\frac{2}{3}$	Watson	200	193	12·5	8	8

* The variation from the normal tube length in these cases arises from the fact that the $\frac{1}{12}$th is really a $\frac{1}{14}$th, though listed as $\frac{1}{12}$th, and the focus of the 8 mm. examined is really 8·5.

To demonstrate the simplicity of the method and the degree of accuracy to which the step micrometer lends itself, the following examples may be given:—

The object selected was a valve of *Surirella gemma*; its length was measured first by an eyepiece micrometer of the usual type and then by the step micrometer.

(1) Leitz objective $\frac{1}{6}$ in., possessing micrometer value 0·00349 mm., length of valve 30·9 intervals of the scale; therefore $30·9 \times 0·00349 = 0·1078$ mm. $= 107·8\ \mu$.

With the step micrometer the value of the same objective is 2 μ at a mechanical tube-length of 178 mm., the valve covers 53·8 intervals of the scale; therefore $53·8 \times 2 = 107·6\ \mu$.

(2) Leitz objective $\frac{1}{12}$ in. oil immersion, micrometer value $= 0·00164$, length of valve 65·5 intervals of the scale; therefore $65·5 \times 0·00164 = 0·1074$ mm. $= 107·4\ \mu$.

With the step micrometer the same objective possesses a micrometer value of 1 μ at a mechanical tube-length of 168 mm., the valve covers 107·5 intervals of the scale; therefore $107·5 \times 1 = 107·5\ \mu$.

In certain cases of frequent occurrence the use of the eyepiece micrometer involves difficulties. The usual eyepiece micrometer has very fine lines, and with some objects it is difficult to see them under unfavourable conditions of lighting. During prolonged observations with an eyepiece micrometer this is very fatiguing and apt to strain the eye.

This defect is particularly pronounced when an object and a micrometer scale are seen by dark-ground illumination, a method which is now largely employed. Indeed, in a dark-ground field the micrometer scale may refuse to come into view.

In the new micrometer the intervals are arranged in groups or steps of ten, each group being indicated in an unmistakable manner by a black echelon rising from the first to the tenth interval. This arrangement possesses the great advantage that the divisions can always be seen distinctly whether the objects be light or comparatively dark.

The micrometer is mounted on the diaphragm of the eyepiece, and can be sharply focussed with the eye-lens, which is mounted in a sliding sleeve. The device is made by E. Leitz, and its cost with eyepiece is fifteen shillings.

Double Demonstrating Eyepiece.

Next in importance to the new micrometer comes a form of eyepiece, introduced also by the firm of Leitz, which enables two observers to use the same objective, and therefore to view the same object. It is called a double demonstrating eyepiece, as no doubt its chief, though not its only, use will be to serve a demonstrator to instruct a student.

The new eyepiece slips into the draw-tube of the microscope like an ordinary eyepiece. The field of view is common to both eyepieces, and contains a pointer which either observer can direct

upon any feature to which he wishes to direct attention.

The arrangement of the device is shown in the subjoined figure :—

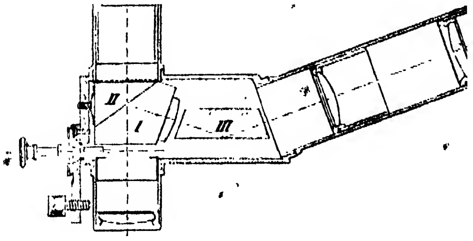
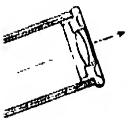


FIG. 2 —Demonstrating eyepiece

I and *II* are two prisms in contact and mounted above the diaphragm between the field-lens and the eye-lens of the eyepiece. The prism *I* has an isosceles cross-section, and its angles are 35°, 35°, and 110° respectively. The prism *II* is rectangular, and its angles are 35°, 55°, and 90°. The prisms are placed with those faces in contact which subtend the angles of 90° and 110° in such a manner as to leave between them a very thin film of air. This film is inclined at an angle of 30° to the axis of the eyepiece and partially reflects the emerging pencil of rays; about two-thirds of the rays pass through the prisms, and one-third is reflected.

The image formed along the axis of the microscope is accordingly brighter than that produced by partial reflection. The centre line of the reflected pencil is inclined at an angle of 70° to the axis of the microscope. *III* is a prism the lower surface of which reflects the pencil upwards at a convenient angle for observation. In order that the two observers may not be in each other's way, the branch tube is fitted with a system of lenses which resembles a terrestrial eyepiece. The image as seen in the side tube is reversed with respect to that which appears in the axial eyepiece; but this scarcely affects the observer, since the oblique attachment of the side eyepiece changes the orientation of the field which is focussed through the principal eyepiece, as the image seen through it is brighter. The adjustment for one eyepiece furnishes a clearly defined image in the subsidiary eyepiece, provided the eyes of both observers can accommodate in a similar manner. The objective in conjunction with the field-lens below the double prism of the two eyepieces forms an image in the plane of the diaphragm below the double prism. This image and the pointer, being both in the plane of the diaphragm, are seen simultaneously in both eyepieces. The pointer can be moved backwards and forwards and turns on a pivot so that its extreme end can be set to any point in the field.

The new eyepiece is well adapted for the instantaneous photography of living bacteria and other moving organisms illuminated by means of a dark-ground condenser; it enables one to observe the object through the side eyepiece and to defer the exposure until a favourable moment presents itself.



This eyepiece makes the instrument to which it is attached into a binocular microscope in a new sense. Its use will certainly not be confined to laboratories; it will equally be a delightful acquisition to tyros discussing pond-life or other subjects in which amateurs take an interest. The 6-diameter power is to be preferred, and as the branch tube is not counterpoised, if the eyepiece tubes do not fit tight it is better to use the microscope in a vertical position.

STANDARDS AND TESTS FOR SEWAGE AND SEWAGE EFFLUENTS.

THE eighth report of the Royal Commission on Sewage Disposal deals with the important question of standards and tests for sewage and sewage effluents discharging into rivers and streams. In their fifth report the Commissioners indicated the desirability of fixing a legal standard for sewage effluents, and suggested that such a standard should be based on (i) suspended solids and (ii) absorption of dissolved oxygen. Their contention then was that the two tests should be taken separately, and they suggested three parts per 100,000 as the limit of suspended solids, and that the effluent after removal of its suspended solids should not absorb more than 0·5, 1, and 1·5 parts dissolved oxygen per 100,000 after one day's, two days', and five days' incubation at 65° F. respectively.

In their present report the Commissioners recognise the difficulty of the separation of the suspended solids, and finally recommend the following as the normal legal standard, viz.: 3 parts per 100,000 of suspended solids, and, including its suspended solids, the effluent shall not absorb more than 2 parts dissolved oxygen per 100,000 after five days' incubation at 65° F.

The importance of this report lies in the fact that not only is a definite legal standard recommended, but that in the opinion of the Commissioners this standard should be a variable one, dependent on the conditions at the outfall, *i.e.* condition of river or stream receiving the effluent and relation of volume of sewage effluent to river water.

The Commissioners state that their experience leads them to think that if the dilution while not falling below 150 volumes does not exceed 300 volumes, the dissolved oxygen test may be omitted and the standard for suspended solids fixed at 6 parts per 100,000, and if the dilution while not falling below 300 volumes does not exceed 500, the standard for suspended solids may be further relaxed to 15 parts per 100,000, and with a dilution of more than 500 volumes all

tests might be dispensed with and crude sewage discharged, subject to such conditions as to the provision of screens or detritus tanks as might appear necessary to the central authority.'

In arriving at the proposed legal standard and modifications, the limit of the amount of dissolved oxygen absorbed by river water without creating a nuisance has been taken as a basis. The report contains data in regard to this point, and the method of determining the standard so far as regards the permissible amount of dissolved oxygen absorption is given. Tables are also given showing the amount of oxygen absorbed by typical sewage liquors and effluents, together with the theoretical amount of dilution necessary to prevent de-oxygenation beyond a certain limit.

A.

BIRTHMARKS AS A TEST OF RACE.

A SUGGESTION was recently made by Herr Bealz that blue patches in the sacral region furnished a valuable test of race. Such marks are found among the children of Chinese, Koreans, Japanese, and Malays. Mr. Gait, Census Commissioner for India, directed that during the 1911 census inquiries should be made into the question. Much information on the subject will be found in Mr. C. M. Webb's Census Report of Burma for 1911, recently issued (vol. i., pp. 281 *et seq.*). The results are not decisive, and there are at present no means of giving statistics showing the prevalence of these marks. But they are found extensively in Burma, and seem to indicate the existence of a Mongoloid strain in the population.

The question of Melanoglossia was also raised by Surgeon-Captain Maynard, I.M.S., and the prevalence of these black marks on the tongue was also investigated by Mr. Webb (*ibid.*, i. 286), They are very infrequent among Aryan immigrants to Burma, but are found to a large extent among Dravidians, and the pigmentation of the tongue seems to vary with the pigmentation of the skin.

It may be hoped that the question will receive further attention in India, and that inquiries will be made on a wider scale to determine the statistical incidence of these marks.

COLONEL J. S. BILLINGS, M.D.

THE world of letters, as well as that of science, has sustained a very great loss in the death of Col. J. S. Billings, M.D., who died in New York on March 11, at the age of seventy-six. Although born in Indiana, and not in New England, he was nevertheless a typical example of what Oliver Wendell Holmes in "Elsie Venner" calls "the Brahmin caste of New England." In person he was tall and powerfully built. He had a well-poised and shapely head, clear-cut features and a very quiet, unassuming and courtly manner.

In spite of his quiet appearance and manner, Dr. Billings was a man of extraordinary energy. He joined the army of the Northern States in 1861 as assistant surgeon, but he was medical inspector of the army of the Potomac when the war finished. During the war he designed most of the hospitals of the northern army. In 1883 he took charge of the Surgeon-General's Library at Washington, a small collection of about two hundred books. During the twenty-two years in which he held the office of director he raised this collection to be one of the finest medical libraries in the world. The catalogue of the library is a stupendous work, giving references not only to medical books, but to pamphlets and extracts, so that it is now indispensable to every worker in medical literature.

From 1891 to 1896 Dr. Billings was professor of hygiene in the University of Pennsylvania, and in 1896 he became director of the New York Public Library, Astor, Lenox and Tilden foundations. This he determined to make one of the seven or eight great libraries of the world, comparable with the British Museum and the Vatican Libraries. He had the satisfaction during his lifetime of seeing a new building provided for the library and the number and value of the books greatly increased. In addition, he arranged for branch libraries to which books could be sent out and consulted apart from the library itself.

Probably no other single man ever did so much for libraries as Dr. Billings. His work was recognised during his lifetime by various universities. He received the honorary degree of LL.D. from five universities—Edinburgh, Harvard, Buda-Pesth, Yale and Johns Hopkins—the D.C.L. from Oxford and the M.D. from Munich and Dublin. But his labours in founding a complete bibliography of medicine by the Surgeon-General's Catalogue and the "Index Medicus," in devising a new method of library cataloguing, and in extending and amplifying the work of the New York Public Library so as to make it a great national institution, will only be fully appreciated by posterity. His kindness of heart, his affectionate disposition and his charm of manner made him beloved by all who knew him, and it will be long indeed before we see his like again.

LAUDER BRUNTON.

NOTES.

THE Geological Society of France has awarded the Gaudry medal, the highest honour it can bestow, to Prof. Edward Suess, of the University of Vienna. The Fontannes prize for the best work in stratigraphical geology during the last five years has been awarded to M. Jean Boussac.

WE are asked to state that the Committee on Research Institute, Chicago, is collecting information about bibliographical material and indexes kept in manuscript by libraries or individuals. Those who have such material in their possession, or know of the whereabouts of any, are desired to communicate with Mr. A. G. S. Josephson, care of the John Crerar Library, Chicago.

IN accordance with the recommendation of the Royal Commission on Vivisection, the Home Secretary has appointed an Advisory Committee to assist him

in the administration of the Cruelty to Animals Act, 1876. The members of the committee, who have been selected from names submitted by the Royal Society and the Royal Colleges of Physicians and Surgeons, are :—Sir Anthony Bowlby, C.M.G., Sir J. Rose Bradford, K.C.M.G., F.R.S., Sir H. Bryan Donkin, Mr. G. H. Makins, C.B., the Lord Moulton of Bank, Dr. S. J. Sharkey, and Dr. C. J. Symonds.

WE learn from *Science* that the National Academy of Sciences will hold, on April 22–24, an adjourned meeting to celebrate the semi-centennial anniversary of its foundation. The academy held its first meeting in New York on April 22, 1863. In addition to the American speakers, there will be three speakers from Europe—Prof. J. C. Kapteyn, Holland, on the structure of the universe; Prof. A. Schuster, London, on international cooperation in research; and Prof. Theodor Boveri, Würzburg, on the material basis of heredity.

The Times of March 10 devotes an article to the recent attempts to introduce, as mosquito-destroyers, into various tropical countries, the tiny fresh-water Barbados fish, locally known as "milliones," and the unsatisfactory results by which such attempts have been attended. In India and Burma more promising results, as pointed out in a paper by Capt. Sewell and Mr. Chaundhuri, recently published in vol. vii. of the Records of the Indian Museum, are likely to attend the cultivation in pools and ponds infested with mosquito larvæ of native species of cyprinodonts, such as several of those of the genus Haplochilus.

THE founder's royal medal of the Royal Geographical Society is not awarded this year, but, with the approval of the King, a casket with a suitable inscription will be presented to Lady Scott, to contain the patron's medal and the special Antarctic medal awarded to her late husband, Capt. R. F. Scott, in 1904. The patron's medal has been awarded to the late Dr. E. A. Wilson, of the National Antarctic expedition, and a gold watch to Lieut. Campbell, who led the northern party of the same expedition. The Victoria medal is awarded to Col. S. G. Burrard, F.R.S.; the Gill memorial to Miss Lowthian Bell; the Murchison award to Major H. D. Pearson; the Cuthbert Peek grant to Dr. Felix Oswald; and the Back bequest to Mr. W. S. Barclay.

ACCORDING to a Reuter message from Hobart, the *Aurora*, the ship of the Mawson Antarctic expedition, returned there on March 14, without Dr. Mawson and the party of six who were left with him in Adelie Land. After leaving the six men behind, the *Aurora* left on February 8. Eight hours after her departure a wireless message was received stating that Dr. Mawson was safe, and the latter afterwards himself sent a message instructing the *Aurora* to return to Commonwealth Bay. A hurricane, however, prevented all communication with the land, and the captain left for Wilde's base. The *Aurora* reached Wilde's base on February 23. Mr. Wilde reported that he had taken possession for Great Britain of the whole area of land from Kaiser Wilhelm II. Land to longitude 101° 30′ east, and as far south as 67° 30′. The trend of the land is almost due east and west, and the coast-line almost on the Antarctic circle. The land is named King George V. Land.

AT the twenty-second annual meeting of the Royal Society for the Protection of Birds, held at the Westminster Palace Hotel, on March 6, Lord Curzon, as reported in *The Times* of March 7, strongly deprecated the continuance of the practice of wearing feathers (other than those of birds used as food) by ladies, and referred to the appalling slaughter of certain kinds of birds of brilliant plumage. In 1911 his lordship stated that in three sales in London no fewer than 41,000 skins of humming-birds, 20,700 of birds of paradise, and 129,000 egret plumes were sold. After adverting to the fact that the egrets are killed while in the breeding plumage, and that certain species or races of birds of paradise are reported to have been exterminated by the plumage-hunters, the speaker observed that although much had been done to stop the trade, yet there were weak links in the prohibitory chain, among these being the lack of prohibition of the import and sale of feathers and skins in this country.

THE International Congress of Historical Studies is to be held in London on April 3–9. The proceedings will consist of general meetings and sectional meetings. Already some 600 members and associates, coming from all parts of Europe, have signified their intention to take part in the proceedings, and delegates from a very large number of universities and learned societies will be present. Readers of NATURE will be interested most in the subsection of Section VII (History of Mediæval and Modern Civilisation), which deals with the exact sciences, natural history, and medicine. In this subsection the following papers have been promised :—"The Annals of the Royal College of Physicians in London," Dr. Norman Moore; "Origin and Development of the Compass Card," Prof. Silvanus Thompson; "Scientific Research in the Early Seventeenth Century exemplified by the Life of Peirese," Prof. L. C. Miall; "Aristarchus of Samos," Prof. H. H. Turner; "Newton's Principia" and "Magic," Mr. W. W. Rouse Ball; "The Mathematical Glories of Great Britain," Prof. G. Loria; "Palissy, Bacon, and the Revival of Natural Science," Sir Clifford Allbutt; and "Historical Method in Science," Mr. W. C. D. Whetham. Every person wishing to become a member of the congress is requested to send to the secretary of the congress, Prof. I. Gollancz, The British Academy, Burlington House, London, W., as soon as possible, name, title, office, and postal address; also, the section or sections with which he desires to be associated.

WE regret to see the announcement of the death of the distinguished cartographer, Dr. E. G. Ravenstein. For the following particulars of his career we are indebted to an obituary notice in yesterday's *Times* :—Dr. Ravenstein was born at Frankfurt-on-Main on December 30, 1834, and belonged to a family who for many years have been known as cartographers of high rank. He came to England when he was about twenty years of age, and his capacity as a carto-

grapher obtained for him a position in the Intelligence Department of the War Office, which he filled from 1855 to 1872. He had been a pupil of the famous Dr. Petermann, and did much to improve British cartographical methods. For the Royal Geographical Society he devoted several years to the compilation of a map, of many sheets, of eastern equatorial Africa, which was published in 1884; and even now, after all that has taken place in the last thirty years, it is a monument of fullness and accuracy, indispensable to the student of the evolution of African geography. He served on the council of the Royal Geographical Society for several years, and was president of the Geographical Section of the British Association in 1891. Among his publications were "Vasco da Gama's First Voyage," published in 1898; a "Systematic Atlas," 1894; and "Martin Behain, his Life and the Globe," 1908, a monumental work, the result of many years of research.

YESTERDAY was the hundredth anniversary of the birth of Dr. Livingstone, and the centenary has been celebrated by many eloquent tributes to the memory of the great explorer. At a meeting of the Royal Geographical Society on Monday an address on the subject of the life and achievements of Livingstone was delivered by Sir Harry Johnston, and the assembly included not only many distinguished geographers, but also relations and others, who were associated with the great explorer during his life. In the course of his remarks, Sir Harry said that a research into the life and work of Livingstone on which he had been engaged for thirty years past, beginning with his (the lecturer's) association with Stanley, with Sir John Kirk, and some of Livingstone's old Swahili followers on the Congo, left him unable to quote anything of importance which could be regarded as serious dispraise of that remarkable man. On the other hand, the repeated reading of Livingstone's works tended to increase his astonishment at Livingstone's achievements with the means in his possession, and to convince him more than ever that Livingstone was the greatest of African explorers, judged not only by his actual achievements but by his character, disposition, and mental capacity. He wrote things, he expressed ideas, in the 'forties, 'fifties, and 'sixties of the last century which seemed to-day singularly modern as conceptions, conclusions, and lines of profitable study. Indeed, it required very little accentuation of his opinions expressed in private letters in 1841 to formulate the phrase, since so potent, of "the Cape to Cairo." He never lost sight of this ideal, and during his last years speculated on its ultimate achievement through the work of Sir Samuel Baker on the Mountain Nile and the Albert Nyanza. The work done by Livingstone for geographical science and for humanity stands out among the greatest achievements of history; and we are glad to unite with all others who are bearing testimony this week to the noble career of the pioneer who passed away forty years ago, and whose work opened up a continent to civilisation.

THE Chingford reservoir of the Metropolitan Water Board, excellent accounts of which will be found in *The Engineer* and *Engineering* for March 14, was opened by his Majesty the King on Saturday last. The reservoir measures about two miles in length by more than one-third mile in width at its narrowest part, and covers an area of 416 acres; the length of embankment is about four and a half miles. The reservoir straddles the old course of the River Lea, and is divided into two parts by a bank near its centre, in order to reduce the fetch of waves. The embankments consist of a puddle trench reaching down to the London clay, and filled with earth, the outer slope being $2\frac{1}{2}$ to 1, and the inner slope 3 to 1 to 4 to 1. The slopes are faced with concrete slabs, the protection being most complete at the north-eastern corners where the highest waves with prevalent winds may be expected. The reservoir is capable of storing 3000 million gallons, to be pumped from the River Lea, and also from the River Lea Navigation, by means of five large Humphrey gas pumps, reference to which was made in NATURE for February 20 (p. 683). These pumps have been put to work with complete success. The large storage capacity required in the Lea Valley is necessitated by the enormous fluctuations in the volume of flow of the Lea. Much of the capacity will only be required at rare intervals, and in normal seasons will facilitate treatment by subsidence; it has been proved that storage alone affects a marked improvement in the quality of water, and thus reduces the work of the filters.

A LECTURE was delivered at the Galton Laboratory, University College, London, on March 11, by Mr. W. Palin Elderton, on the mortality of the phthisical under sanatorium and tuberculin treatments. Mr. Elderton showed that at present the best comparison is reached by studying the subsequent mortality of those who have undergone various kinds of treatment. The mortality of incipient cases under sanatorium treatment is, generally speaking, more than three times that of the general population, while advanced cases show a mortality of ten times, and far advanced cases a mortality of about forty times that of the general population. He discussed some interesting results from Dr. Lawrason Brown's statistics of the Adirondack Sanitarium, New York, but owing to the selection of patients and the increased proportion of early cases among the patients admitted more recently it is impossible to decide to what extent sanatorium treatment has improved. The statistics show, however, that at this particular sanatorium the authorities are now better able to say which cases will improve under treatment and which cases are cured. Mr. Elderton showed that the mortality of cases having tubercle bacilli in the sputum is two and a half times to four times as heavy as that of the cases which are without this symptom, and this result sometimes enables the extent to be estimated to which data are influenced by the admission of an undue proportion of early cases. There is no evidence to prove, he continued, that tuberculin, as compared with ordinary sanatorium treatment, appreciably lengthens the life of the consumptive. If the use of tuberculin had the marked results claimed by some definite evidence of its effect on mortality would have been anticipated.

ɪR. O. G. S. CRAWFORD, in the February issue of *n*, discusses a remarkable funereal vase, now in the e of Wight Museum, which was found on Nunwell wn, Isle of Wight. The form and ornamentation the vase, among those found in this country, are que, and the nearest analogue to it appears in tral Germany, whence it was probably imported. e remains associated with the vase are identified Prof. A. Keith as belonging to a typical individual the Bronze age type, a race which probably brought vase with them from the Continent. This theory strengthened by the fact that the Isle of Wight athwart the path of every invader of Wessex; island has been, from the earliest times, in close ch with the opposite coast of France, and the es followed the same route as their predecessors the Bronze age.

'o the *Anales del Museo Nacional*, Buenos Aires, xxiii. (incorrectly lettered xx. on side of cover), ɪ. F. Lahille describes a new species of malaria-roducing mosquito from Tucuman under the name f *Anopheles tucumanus*, and likewise gives a new ormula for indicating the wing-venation in this and ther members of the group. He also states, in eferring to the Argentine representative of *Stegomyia asciata*, that the alleged sexual difference in the umber of joints in the palpæ of that species is in-orrect, and that the difference is really due to the xtremely minute size of the terminal one in the emale, which renders its recognition very difficult.

IN the same volume (*An. Mus. Buenos Aires*, xxiii., . 269) Mr. Lahille describes, as *Phocaena dioptrica*, new porpoise from the estuary of the La Plata liver. It is described as having the upper part of the ead and body, as well as the lips, deep lustrous lack, but on the flanks this gives place suddenly to ilk-white, which occupies the whole of the under-arts, the flippers and a semicircle above each eye eing also white. There are sixty-eight vertebræ, and $\frac{-21}{19}$ teeth. On p. 391 of the volume Mr. A. Gallardo escribes a specimen of Fitzroy's dolphin (*Lageno-ynchus fitzroyi*) stranded at Mar del Plata in Decem-er, 1912.

To Dr. N. V. Nasonov, director of the museum St. Petersburg, we are indebted for a copy of a per on *Ovis arcar* (or *arkar*) and its relatives, pub-shed in the *Bull. Ac. Imp. Sci. St. Pétersbourg*, 12, pp. 1–32, plates i.–v.; the text being, unfor-nately, wholly in Russian. Brandt, in 1852, gave e name *O. arkar* (from the Turki designation of all g wild sheep) to the wild sheep of the Ust-Urst ateau, Transcaspia; but in Blasius's "Säugethiere eutschlands" the name was corrupted into *arkal*, which title the animal has been almost universally own. Most naturalists regard the arkar as a race the sha or urial (*O. vignei*), but Dr. Nasonov is opinion that it should rank as a species, with three cal races. One of these, from the Kopet-Dagh, viding Persia from Turkestan, has been previously med *O. v. varentzowi* by Dr. Sátunin, but the third, which is based on two heads collected by Karelin, it is believed in the neighbourhood of Astrabad, is de-scribed as new, under the name of *O. a. dolgopolovi*.

PROF. OMORI, the well-known Japanese seismo-logist, directs attention in the Tokyo *Asahi* (January 29) to a remarkable coincidence between the frequency of earthquakes as recorded by the seismometer at Tokyo and the amount of rain- and snow-fall in north-western Japan. The relationship is borne out by statistics covering the whole of the Meiji era—forty-five years from 1867. The number of earthquakes recorded annually at Tokyo between 1876 and 1909 is found to be practically in direct ratio to the amount of rain and snow-fall at Niigata and Akita, on the Japan Sea coast. The curves for earthquake fre-quency in Japan show that these disturbances gradu-ally increase in number over a period of years, and then undergo a corresponding decline, and in accord-ance with a recognised principle destructive earth-quakes are most likely to occur in a period of mini-mum earthquake frequency. Such minima occurred in 1883, 1893, and 1903, and very violent earthquakes took place in 1884 and 1894. These periods, it is noted, corresponded with a conspicuous freedom from rain- and snow-storms in the north, while in the years of maximum earthquake frequency at Tokio—*i.e.* with no violent shocks—the amount of rain and snow falling in the north was much above the average. No reason for this apparent relationship can at pre-sent be assigned.

A NEW form of rain-gauge has been constructed by Messrs. Negretti and Zambra, of Holborn Viaduct, under the directions of Dr. H. R. Mill, of the British Rainfall Organisation, and the instrument has been named the "Seathwaite" rain-gauge. It is designed especially for use at out-of-the-way stations, where the gauge is visited at only long intervals. The registrations it affords will be of great value to science in those districts from which at present rainfall records are scarce, owing to the difficulty of frequent access, and it will probably be greatly appreciated by borough councils, waterworks, and various branches of engineering. The feature of especial interest in the construction is that it collects through a 5-in. funnel, the dimension approved by the British Rainfall Organisation, a large quantity of water, the receiver having a capacity of 30 in. of rain. The advantage over the older types of gauge is effected by enlarging the funnel from the 5-in. rim to a cistern of 8-in. diameter. As a protection against evaporation or frost, the gauge is lined with an insulating material. The measuring apparatus is quite apart from the gauge, and is carried in a small wooden case by the observer. A tentative measurement is first made by means of a graduated cedar rod, which gives approxi-mately the depth of water in the gauge. For the ordinary measurement a dipper, made of copper, holding exactly 5 in. of rain, is used, and for the residue after the several 5 in. an ordinary glass measure is used, graduated up to 1 in. in subdivisions of 0·05 in. The total height of the gauge is 28 in.,

but only 13 in. remain above ground. The gauge is made of stout galvanised iron. Attention has been given to every detail in construction with the view of securing the greatest possible accuracy and with a minimum of trouble to the observer.

IN the Journal of the Meteorological Society of Japan for November, 1912, we find five articles. The first, by Mr. T. Hirata, is on wind in Korea, and other important meteorological phenomena. The second, by Mr. K. Asakura, is on the Red Stream, or Akashiwo, near Kanagawa. He remarks that in August it was very hot and many fish died, but not so many as in the previous year. Mr. K. Nakamura discourses on the climate in the Bonins, whilst Mr. N. Takenaka gives the results of twenty-seven years' observations in Kyūshū on the velocity and direction of the strongest winds. The only paper published in Roman characters is one by Mr. S. Fujiwhara. Its title is "Periodic Changes of Climatic Elements in Relation to the Oscillation of the Earth's Axis." The first climatic element to which he directs attention is the freezing of a small lake called Suwa, in Central Japan. In the sheet of ice two or three large fissures are usually developed, and there is a belief that this splitting is somehow or other connected with the weather and crops of the following year. For this reason a record has been kept since A.D. 1444 of the first date of the complete freezing up of this lake. These dates, in relation to years, have been plotted on squared paper. The resulting curves show, but not very clearly, a tendency for warm winters to recur every seven years. These curves of freezing are compared with temperature curves at several places in Japan, and curves showing the variation in latitude.

MESSRS. WRATTEN AND WAINWRIGHT, LTD. (Croydon), are issuing a second and revised edition of the descriptive list of their "light filters," which have gained for this firm a world-wide reputation. It includes nearly ninety varieties, each with a statement of its special use, whether in spectroscopy, photomicrography, or the getting of monochromatic light, &c., and its stability when exposed to light. It includes also the photographed absorption spectrum of each filter over a range of light intensities of from one to ten thousand, and the spectrum sensitiveness of the plates that the firm makes. There are filters designed for use with mercury-vapour lamps, passing respectively the yellow, green, and violet lines, and we are told of one filter that it transmits 72 per cent. of the light of the green line and ½ per cent. of the yellow, while by sacrificing 50 per cent. of the green light the yellow can be "completely absorbed." The list forms an excellent guide for those who use colour screens for any purpose.

AN address, delivered by Prof. Millikan at the recent meeting of the American Association for the Advancement of Science, is reproduced in *Science* for January 24. It deals with the atomic theories of energy, and shows that the only one which appears capable of explaining the whole of the facts of radiation, whether of light or of X-rays, is that advanced by Prof. Einstein, who, with Sir J. J. Thomson, supposes the radiation is concentrated in space along lines of force or Faraday lines, and not distributed uniformly over the wave surface, and further believes, with Prof. Planck, that along these lines the energy travels in atomic form and not as a continuous stream. The main objection to the general adoption of such a theory at the present time is its failure to explain the well-known facts of interference and diffraction of light.

THE third issue of the *Taschenbuch für Mathematiker und Physiker*, by Messrs. Teubner, contains a portrait of the late Prof. F. Kohlrausch, and a short account of his life. Five pages of the mathematical part are devoted to a report of the organisation and activities of the international commission on the teaching of mathematics. Other special articles deal with the theory of groups, with multiple valued functions and with analytical mechanics. The physical half has sections of the "quanten" theory, on physical chemistry and on crystallography. In both parts of the book vector methods are freely used, the quaternion being defined as the complex product of two vectors. The section on the "quanten" theory, by Prof. Sommerfeld, of Munich, gives a clear account of both the advantages and the difficulties of the theory. The pocket-book is well indexed, and contains a list of all the most important books on mathematics and physics which have appeared during the last two years.

IN the account, published in the issue of NATURE for April 11, 1912 (vol. lxxxix., p. 143), of the proceedings in connection with the one hundredth anniversary of the foundation of the Academy of Natural Sciences of Philadelphia, celebrated in March, 1912, it was stated that certain volumes would be published as a permanent record of the event. We have now received a copy of vol. xv. of the second series of the Journal of the academy, which has been published in a special form in commemoration of the hundredth anniversary celebration. It consists of two parts bound together, the first of which runs to 142 pages, and is concerned wholly with the proceedings of the centenary meeting. The second part contains twenty-two fully illustrated scientific memoirs, which together occupy 591 pages, and are illustrated by fifty-nine full-page plates, 11 in. by 14 in. Part i. consists chiefly of the addresses delivered by the mayor in welcoming the delegates, by the president, which took the form of a history of the academy, and by various speakers at the banquet, together with lists of delegates and selections from the congratulatory letters and cablegrams received from learned societies throughout the world. Some of the memoirs published in the second part of the volume were those read during the anniversary meetings. The frontispiece is a well-executed picture of the academy buildings, which, previous to the centenary meeting, were much enlarged and rendered fireproof with the assistance of the legislature of the State. The handsome volume forms a fitting memorial of an interesting series of meetings.

OUR ASTRONOMICAL COLUMN.

THE 100-IN. REFLECTOR AT MOUNT WILSON.—Some years ago the Mount Wilson Observatory ordered from France a 100-in. diameter mirror, the French foundry being the only one in the world which would undertake the casting of such a large mass of glass. The mirror, when delivered in California, was found not to be up to the standard of contract quality, and the French firm undertook to set about casting a new one. In the meantime, as an experiment, it was decided to figure the disc, and Prof. Ritchey worked away at it in the workshop at Pasadena. On the completion of his task, it appears from a note in *The Observatory* (March) that the tests have shown that the mirror is practically useless. It will be some time before the more perfect disc is procured, but it is hoped that the second attempt will be quite successful.

SOLAR RADIATION DURING THE ECLIPSE OF APRIL 17, 1912.—In the form of an extract from the *Comptes rendus de la Société Scientifique*, of Warsaw, we have received a paper in which Dr. W. Gorcynski describes the observations of the insolation made at Warsaw during the partial eclipse of the sun which occurred on April 17, 1912. The diminution of the solar radiation readings began about half an hour before the eclipse, and remained below the normal for the date for nearly the same time after. The maximum reduction of the solar radiation attained 89 per cent. at Warsaw, where 0·88 of the disc was covered at maximum phase, and the radiation curve agrees fairly well with the phase curve. Between noon and 4 p.m. each sq. cm. of surface received 110 great calories, at normal incidence, less than usual, and the drop in temperature, as recorded in the screen, was between 2° and 3° C.

BANTU STAR NAMES.—No. 12, vol. xii., of *Man* contains an interesting article by Miss A. Werner discussing the names by which the stars are described in Bantu by the tribes of Nyasaland. Miss Werner's general impression is that nearly, if not quite, all the peoples with whom she has come into contact have lost much star knowledge which they once possessed. The name for the Pleiades is always etymologically connected with agriculture, being derived from a root, *lima*, meaning "to cultivate," thus indicating that the Zulus, Swahilis, &c., have employed this asterism, as have so many other primitive races, as a substitute for the modern calendar. The "belt" stars of Orion seem always to be connected with hunting, and the name for Venus conveys generally the idea the planet is the moon's wife. The names applied to Jupiter also suggest a connection with hunting, a native explanation being that a hunting expedition should start on a night when Jupiter is overhead just before dawn. Several other of the names given are of special interest, and tend to show that the astronomical observations of primitive races are essentially utilitarian in character.

THE EXPLOSION OF WORLDS.—Some interesting speculations as to the possibility of such a world as the earth being shattered by the explosive energy of the now pent-up internal forces are published by Mr. Hudson Maxim in the February number of *The Fortnightly Review*. Among other things, he shows that the pressure of the earth's crust is so great that the most powerful explosive known, in any quantity, would fail to do more than shake it locally. Gravitational pressure is so enormous that were two solid steel balls, as large as the earth and as hard as the Harveyised surface of armour-plate, gently placed in contact they would flow together like water, and would have no variation from a true sphere greater than fifty miles high. By such arguments Mr. Maxim demonstrates the enormous strength and rigidity of the terrestrial sphere, and shows that it is immune from the effects of any shattering force less than the collision of the solar system with another celestial system.

THE DETROIT OBSERVATORY.—The first issue of the Publications of the Astronomical Observatory of the University of Michigan (vol. i., pp. 1–72) contains, *inter alia*, a most interesting account of the observatory and its work. The observatory also makes seismographic observations, and the records of the earthquakes recorded from August, 1909, to January, 1912, are given in the present publication.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE meetings of the Institution of Naval Architects opened on Wednesday, March 12, in the rooms of the Royal Society of Arts. During the three days over which the meetings extended, fourteen papers were presented for discussion. The gold medal of the institution for 1912 was presented to Admiral Sir Reginald Custance, and premiums were awarded to Prof. Gümbel and to Mr. A. Cannon. The Marquis of Bristol, in his presidential address, referred to the loss the institution had sustained in the death of Sir Wm. White, and hoped that some memorial of a permanent character would be instituted by the various societies with which he had been connected, and that such memorial might take a form of practical service to the profession.

Mr. D. B. Morison gave some interesting data regarding the influence of air pumps on the military efficiency of turbine-driven warships. According to the latest cruiser practice, a vacuum of 28·5 in. is required at full power in sea water at 55° F. If, under conditions of maximum and constant generation of steam in the boilers, the vacuum falls from 28·5 to 27·5 in., then the loss in power is about 6 per cent. The minimum capacity of an air pump is determined by the quantity of air in the feed water as it enters the boiler, without provision for insidious leakage. From his experience with high-vacuum plants of the highest class, Mr. Morison does not believe that ideal air-tightness can be maintained under the severe conditions of war; hence the necessity for the provision of an air margin in the capacity of the air pumps. Various types of air pumps are discussed in the paper.

Sir Charles A. Parsons states in his paper on mechanical gearing that such gearing for reducing the speed between the turbine and the propeller is now well advanced beyond the experimental stage. This type of gearing is now in service on vessels representing a total of 26,000 h.p., and there are others under construction aggregating 120,000 h.p., including two installations of more than 20,000 h.p. each. The Channel steamers *Normannia* and *Hantonia* continue to show an economy, as compared with other turbine steamers of somewhat different design on the same service, of about 40 per cent. The *Normannia's* gearing, inspected recently, shows no signs of wear. Comparative coal consumption trials have been carried out on a cargo steamer, built for the Cairn Line, and fitted with turbines and mechanical gearing, and on a sister ship, the *Cairngowan*, with exactly similar boilers and propeller, but with triple expansion engines. The coal was of the same quality, and measured in the same way on both ships, and the geared turbine ship has shown a saving of 15 per cent. in the coal consumption. So far, no limit in regard to the surface speed of the teeth in the gearing has been discerned, and there is no evidence of any limit to the power that can be transmitted by

mechanical gearing with gear-wheels suitably designed. Careful investigations have been made of the causes producing noise in the gearing, and show that the noise is due to slight inaccuracies in the teeth; it should be noted that the noise is an engine-room noise only, and is not perceptible elsewhere. This has led to a method of cutting the gear-wheels, which greatly reduces the errors involved in reproducing the parent gear. Two rotating tables are used in the new machine; the wheel to be cut is fixed to the upper one, and is given a creep in advance of 1 per cent. in relation to the motion of the lower table; the lower table is driven by worm-gearing at 1 per cent. less speed than would be the case if a single table were employed; hence the wheel on which the teeth are being cut has a motion compounded of the motion of both tables, and equal to that required for the given number of teeth to be cut. This device has the effect of causing the errors in the teeth to lie in very oblique spirals around the wheel, and also reduces the errors themselves. In the actual machine, the errors are reduced to about one-fifth of the original magnitude.

Mr. W. Reavell contributed a paper on the use of compressed air for working auxiliaries in ships propelled by internal-combustion engines. It is of interest to note, in the operation of deck winches in cargo steamers, that although steam at a pressure of 90 lb. per sq. in. may be supplied, the actual pressure demanded by the winches in working did not exceed 16 lb. per sq. in. Earlier attempts to deal with such cargo-hoisting problems with high-pressure compressed air have been wasteful; modern installations in which air at low pressure is used for operating the winches have been successful and economical.

Baron A. Roenne contrasted the advantages and disadvantages of airships and aëroplanes, and gave a suggested design for an airship 853 ft. in length and 72 ft. 3 in. in diameter, having a displacement of 104 tons at 0° C., and 760 mm. of mercury. A speed of fifty-two miles per hour could be obtained with 2000 h.p., and it should be possible to carry a regular passenger service and to master the air on almost every day of the year.

In a paper on the longitudinal stability of skimmers and hydro-aëroplanes, Mr. J. E. Steele states that the most notable machine in the aëroplane show at Paris this year from the point of view of inherent longitudinal stability was one designed by M. Drzewiecki. The principle embodied in this design is that of difference in pressure intensity on the forward and the after curved planes, due to the different cross sections. On the involuntary rising of the front part of the machine, the increase in the angle of attack has quite a different effect on the fore to what it has on the rear plane. The pressure per sq. ft. on the front plane is but very gradually increased for changes of the angle of attack between the limits of 5° and 18°, whereas that on the after plane increases very rapidly with the angle at which the wind meets it. The result is an excess of lift aft, which restores the machine to its original position. The converse holds if the front of the machine is involuntarily depressed. The reduction in the angle of attack leaves the pressure on the front plane but slightly altered, but reduces quickly that on the rear plane, resulting in a drop of that part to the normal position.

Mr. G. S. Baker gives the first published account of systematic research work carried out at the William Froude tank at the National Physical Laboratory. The experiments had for their object the testing of the effect upon the resistance of the ship of varying the relative lengths of the entrance to run (*i.e.* those portions of the bow and stern respectively which are clear of the perfectly parallel midship body), maintaining the same general form, water-line, and principal dimensions. Five parent models have been chosen, and with each of these, four or five proportions of entrance and run have been tried. Another set of experiments has been carried out with the view of testing the effect upon model resistance of various possible terminations to the lines, both in fore and after body. The alterations tried have affected both the area curve and the water-line, and, in addition, the effect of the presence of the rudder has been tested in one case.

Mr. C. E. Inglis contributed a mathematical paper dealing with the stresses in a plate due to the presence of cracks and sharp corners. Exact results are obtained for the distribution of the stresses around a hole in a plate, the hole being elliptic in form. If the axes of the ellipse are equal, a circular hole is obtained; by making one axis very small the stresses due to the existence of a fine straight crack can be investigated. One of the several results obtained may be quoted. A strip of plate of indefinitely great width is pulled in the direction of its length, the tensile stress intensity being R. There is an elliptic hole in the plate having major and minor axes, $2a$ and $2b$ respectively, and arranged so that the major axis is at right angles to the pulls. At the edge of the hole situated at the extremity of the major axis, a tensile stress occurs having an intensity $R(1+2a/b)$. This stress decreases rapidly as we proceed along the section of the plate made by producing the major axis, and, at a short distance from the edge of the hole, attains the normal value R. It will be seen that the maximum value becomes very large if b is made small; if $a/b=1000$, the maximum tensile stress has a value of 2001 times the intensity of the mean stress. In this case the ellipse would appear as a fine straight crack, and a very small pull applied to the plate across the crack would set up a tension at the ends sufficient to start a tear in the material. The increase in the length due to the tear exaggerates the stress yet further, and the crack continues to spread in the manner characteristic of cracks.

A paper on the distribution of stress due to a rivet in a plate, by Prof. E. G. Coker and W. A. Scoble, is also of considerable interest. In a former paper measurements have been described of the differences of principal stresses at points in plates having notches and holes of various kinds. In the majority of the former cases, the stress distributions were such that the minor principal stresses vanished or were of little importance. In many practical problems, both principal stresses are of considerable magnitude, and it is then important to obtain each stress separately. The present paper describes a general method for determining both the sum and the difference of the principal stresses at a point in a plate, considered as averages taken over the normal at the point, and bounded by the two faces of the plate. The stress difference may be measured directly by mechanical or optical means, advantage being taken in the latter method of the fact that plates of glass, celluloid, and like transparent bodies, become temporarily doubly refractive when stressed, and that in polarised light there is, in consequence, a relative retardation, R, between the ordinary and extraordinary rays, which is proportional to the stress difference, and to the thickness T of the plate. If p_r and p_t are the magnitudes of the principal stresses, the law is given very approximately by $R=c(p_r-p_t)T$, where c is an optical constant. The sum of the principal stresses may be determined by taking advantage of the fact that a plate, when subjected to stresses in its own plane, alters in thickness. Thus, if both stresses p_r and p_t are pulls, there is a lateral contraction of amount $(p_r+p_t)T/mE$, where m is Poisson's ratio

and E is Young's modulus. Hence by determining m and E and also by measuring the changes in thickness of a stressed plate, the sum of the principal stresses may be evaluated as an average throughout the thickness of the plate. Having obtained the sum and difference, it is a simple matter to state the values of p_r and p_t separately. A new form of instrument is described in the paper, specially devised for measuring small changes in thickness of a stressed plate. This instrument is partly optical, readings being obtained by means of a ray of light reflected from a mirror which is rotated partially by the strain to be measured. One millimetre on the scale is equivalent to two millionths of an inch change in the lateral dimensions of the specimen. A number of experimental determinations are given in the paper and show very concordant results.

COLLOIDS AND THEIR VISCOSITY.

SPECIAL interest attached to the meeting of the Faraday Society, held on Wednesday, March 12, in view of the distinguished foreign guests who took an active part in the proceedings. These included Prof. Pauli (Vienna), Dr. Wolfgang Ostwald (Leipzig), Prof. Victor Henri (Paris), Prof. Freundlich (Brunswick), and Prof. Nernst (Berlin).

The meeting took the form of a symposium upon colloids and their viscosity, and the afternoon session was opened by Dr. Wo. Ostwald, who, in an introductory address of a general character, showed the importance of viscosity measurements as a means of study of the colloidal state. In the course of his remarks, which were fully illustrated with examples, he laid special stress upon the need for kinetic, as opposed to static, methods for the investigation of heterogenous systems, and in this connection also emphasised the value of viscosity measurements. An illustration of this principle was immediately afforded by the communication of Profs. Freundlich and Ishizake on the rate of coagulation of $Al(OH)_3$-sols as measured by the viscosity change, the results of which were in complete accord with those of Paine upon copper oxide-solutions, using a totally different method. The following empirical formula proved to express the experimental results of coagulation by potassium salicylate with great exactness:—

$$dx/dz = 2Kz(1+bx)(1-x)^2,$$

where K is a constant depending on the concentration of the electrolyte, z represents time, and x the amount of precipitated particles, the latter taken as proportional to the increase in viscosity. From the equation in its more general form,

$$dx/dt = K_1 f(U)(1-x)^2,$$

Freundlich and Ishizake drew the following conclusions. The term $(1-x)^2$ suggests the coagulation process to be primarily a reaction of the "second order" in which the colloidal particles may be supposed to unite in pairs, the cause for which union is to be found in an asymmetry of their electric charges (expressed in the term $f(U)$) due to unequal degrees of electrolyte-adsorption. The degree of asymmetry was found to be proportional to the time z, to the number of precipitated particles, and to an exponent of c, the concentration of electrolyte thus:—$f(U) = \lambda c^q z(1+bx)$, where λ, q, and b are constants.

Prof. Pauli directed attention to the importance of viscosity measurements in the study of "emulsoid" colloids in a survey of the chief results obtained in his own school, showing what important generalisations as to the ionisation and degree of hydration of proteins in solution had been arrived at by this means. His experiments proved, for example, that at the iso-electric point, where, by definition, the ionisation of the protein is a minimum, a close correlation existed between that property and (1) osmotic pressure, optical rotation, viscosity, and imbibition of water, all of which reached their lowest value, and (2) precipitability by alcohol which was at its maximum. With increase in concentration of protein ions, caused by addition of either acid or alkali, a corresponding rise was found to occur in the value of the first set of properties and a fall in the precipitability.

The evening session was chiefly devoted to a discussion of the factors concerned in the viscosity of colloidal solutions and the interpretation to be placed upon the viscosity value. Mr. Emil Hatschek developed a mathematical theory of the viscosity of two-phase systems, showing that for "suspensoid" equally with "emulsoid" colloids, viscosity depended upon the volume-ratio of the two phases, and was independent of the size of the colloidal particles. In the case of the former, as shown also by Einstein and Bancelin, the viscosity increased in linear ratio with the volume of disperse phase, while in the case of "emulsoid" colloids the viscosity of the system was equal to $\frac{\sqrt[3]{A}}{\sqrt[3]{A}-1}$, where $A = \text{ratio}: \frac{\text{volume of system}}{\text{volume of disperse phase}}$, the viscosity of the continuous phase being taken as unity. Experimental support was adduced in both instances, and interesting confirmation also obtained of the above formula in the case of paraffin soap-solution emulsions, where viscosity had been determined by means of Couette's apparatus, and direct measurement could be made of the volumes of both phases. Prof. Henri gave a critical survey of the various direct and indirect methods available for volume-measurement of colloidal particles. He showed that, among the indirect methods, that of Perrin (based on the distribution with depth of colloidal particles after settling), and that of Rayleigh (by measurement of the intensity of light after lateral diffusion through colloidal solutions) were among the most trustworthy, since in the formulæ used for calculation of r, the radius of the colloidal particles, the term r was raised to the third and sixth power respectively. As a result of work with $Fe(OH)_3$-sols Prof. Henri, expressed the view that apart from the question of phase-ratio, or size of colloidal particles, the *arrangement* of the latter might have a very important influence upon the viscosity of the system.

An interesting discussion followed, in which, among others, Dr. Ramsden, Dr. S. B. Schryner, Dr. McBain, and Dr. C. J. Martin took part. In the absence of the chairman, Dr. R. T. Glazebrook, the chair was taken by Mr. Emil Hatschek.

ATMOSPHERIC HUMIDITY AND TEMPERATURE.

TWO papers on the psychrometer formula, reprinted from recent Proc. Roy. Soc., Victoria (vols. xxiv. and xxv.), discuss a modification, proposed by Dr. Ekholm, of the Stockholm Meteorological Office, to be made in Regnault's formula for the wet- and dry-bulb hygrometer, which would have important consequences if confirmed. The formula so modified would be $x = \eta f - AB(t-t')$, where x and f are respectively the actual vapour-pressure and the saturation vapour-pressure at the temperature t' of the wet bulb. A is the ordinary psychrometric constant, and η the coefficient, less than unity, inserted by Ekholm to allow for a supposed diminution of vapour-pressure at the surface of the wet bulb due to hygroscopic action of the material covering it. The first paper, by Dr. E. F. J. Love

and Mr. G. Smeal (Government research scholar), dealt with temperatures near the freezing point, and the second, by Mr. Smeal, dealt with temperatures up to 31·4° C. The discussions appear to have proved that the suggested coefficient, being so nearly unity, is not wanted, especially if the covering be thin muslin and be kept clean. The factor, A=0·00072, derived from the observations and careful computations, varies slightly according to wind force. In the event of any modification of the simple formula being accepted it might be in this sense, but we suggest that it would be more to the point if one formula were selected from among those which already exist, and be recommended for general adoption.

A useful paper on the wet-bulb thermometer and tropical colonisation, by Prof. J. W. Gregory, F.R.S., is published in the Journal of the Scottish Meteorological Society (vol. xvi., No. xxix.). The author points out that the view that the tropics are injurious to health is prevalent, but the explanations why this is so are very unsatisfactory. Heat is mostly regarded as one of the principal factors of tropical maladies, but it is now recognised that no locality with a *dry* climate has a temperature so high as to be injurious to health; in fact, the hottest districts in a country are often the healthiest. Healthiness of tropical localities does not depend upon diurnal or annual range of temperature, and moisture is not necessarily injurious; the latter is better for some constitutions, but heat and moisture combined may be very harmful. Experiments appear to indicate that "the industrial development of any locality where the wet-bulb temperature commonly exceeds 80° will be almost, and if it exceed 88°, quite impossible." But statistics supplied to the author by the Meteorological Office show that such high wet-bulb temperatures do occur in well-populated tropical localities. The author laments that the distribution of such temperatures is not well known, and refers to the collection of observations in Australia by Prof. W. A. Osborne, of Melbourne. The annual summary of the Australian Monthly Weather Report for 1910 (received by us in July, 1912) contains monthly wet-bulb isotherms from 9h. a.m. observations, with means of 80° in the north-west in December–February inclusive.

RECENT ADVANCES IN SCIENTIFIC STEEL METALLURGY.[1]

IT has already been pointed out that the year 1870 marked the commencement of the tungsten era, and 1880 that of the tungsten-chrome era. But the years 1899 to 1902 inaugurated what is destined to be the most remarkable epoch of the three, namely the vanadium era. During these years was carried out in the experimental steel works of Sheffield University a series of researches on the influence of the comparatively rare metal vanadium on plain carbon steel and on alloy steels. At that time (1899) vanadium was 60*s*. per lb. In 1912, owing to the large demand, the cost had fallen to 10*s*. per lb.

The first report, having reference mainly to cutting steels, was issued in June, 1900, and the second and third reports respectively in January and June, 1902. The results are briefly summarised in the two next paragraphs.

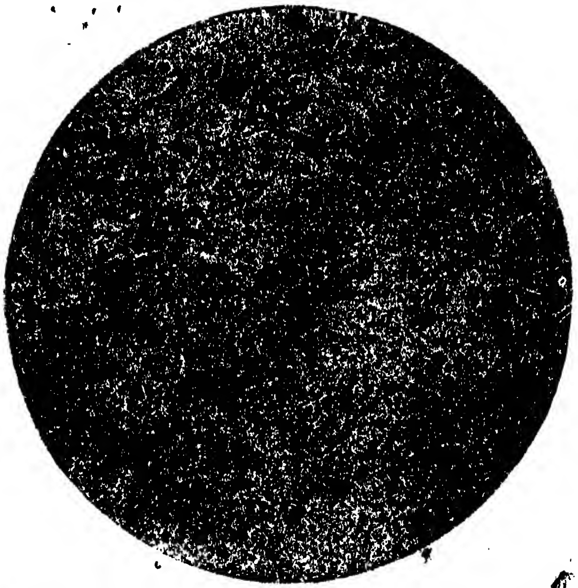
June 28, 1900.

"The results of this preliminary investigation have profoundly impressed upon my mind the future before vanadium as a steel-making element, and even at this early stage of my knowledge of its effect, I venture to say that its action resembles that of tungsten, but that it is from ten to twenty times as powerful as the latter element."

January 14, 1902.

"It is already evident that as a steel-making element vanadium will place in the hands of metallurgists and engineers a very powerful weapon, because it is now demonstrated beyond doubt that the addition of a few tenths per cent. of vanadium raises the elastic limit of mild structural steel at least 50 per cent., without seriously impairing its ductility or presenting any difficulty in the hot or cold working of the steel."

(*a*) Carbon, 0·60 per cent. Vanadium, 0·71 per cent. Pale ground mass of slightly vanadiferous ferrite. Dark areas, troostitic vanadium pearlite. Less dark areas, sorbitic vanadium pearlite. White cell walls and masses, "B" iron cementite, resulting from thermal decomposition of laminated iron pearlite, a few areas of which still remain undecomposed.



(*b*) Carbon, 0·93 per cent. Vanadium 5·84 per cent. Ground mass of sorbitic vanadium pearlite, overlaid with a broken and irregular mesh-work of vanadiferous ferrite.

FIG. 6.—Magnified 450 diameters.

[1] Discourse delivered before the Royal Institution on Friday, January 24, by Prof. J. O. Arnold, F.R.S. Continued from p. 49.

Some of the results upon which these paragraphs were founded are tabulated below. Perhaps the most remarkable results in this series are:—

(1) A plain carbon steel containing about 1 per cent. of carbon has a yield point of 35 tons per square inch, a maximum stress of 60 tons per square inch, an elongation of 10 per cent. on 2 inches, and a reduction of area of 10 per cent. The addition to such steel of about 0·6 per cent. of vanadium raised the yield point from 35 to 65 tons, the maximum stress from 60 to 86 tons per square inch, still leaving an elongation of 7 and a reduction of area of 8 per cent.

(2) A steel containing 0·25 per cent. of carbon and 3·3 per cent. of nickel registered a yield point of 33 tons, a maximum stress of 42 tons per square inch, an elongation of 26 per cent. on 2 inches, and a reduction of area of 53 per cent.

A practically identical steel, but containing in addition about 0·25 per cent of vanadium, recorded a yield point

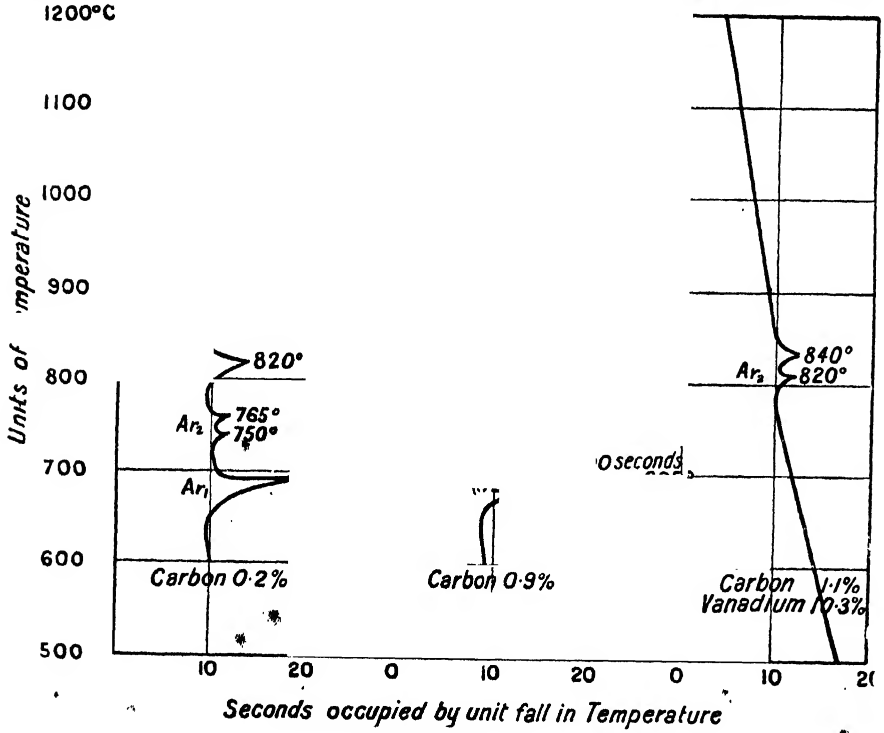


FIG. 7.

of 50 against 33 tons, a maximum stress of 68 against 42 tons per square inch. The elongation was 17 per cent. on 2 inches, and the reduction of area 36 per cent.

(3) A steel containing 0·25 per cent. of carbon and about 1 per cent. of chromium registered a yield point of 27 tons, and a maximum stress of 41 tons per square inch, together with an elongation of 36 per cent. on 2 inches, and a reduction of area of 55 per cent.

The addition of 0·25 per cent. of vanadium raised the yield point from 27 to 40, and the maximum stress from 41 to 55 tons per square inch. The elongation was lowered from 36 to 26, and the reduction of area from 55 to 53 per cent.

Thus vanadium differs from tungsten in having an almost magically beneficial effect, not only on cutting, but also on structural steels. In connection with vanadium steels it is an interesting fact that the series of copyrighted and published reports issued from Sheffield University during the years 1900 to 1902 were unconscious plagiarisms of a series of American patents issued during the years 1904 to 1908. This seems to constitute a remarkable problem in psychology.

A study of what may be called the pure science of vanadium steels made by the lecturer and Prof. A. A. Read, of the University of Wales, has yielded results of profound theoretical and probably practical importance. It was shown that vanadium does not seem to form a double carbide with iron. It gradually wrests the carbon from the carbide of iron until when about 5 per cent. of vanadium is present Fe_3C cannot exist, and only a vanadium carbide, V_4C_3, containing 15 per cent. of carbon is present, and this constituent is constant, at any rate in tool steels containing up to 14 per cent. of vanadium. The micrographic analysis of these alloys, as shown in Fig. 6 (*a*) and (*b*), has resulted in the discovery of three new constituents, viz. vanadium pearlite, vanadium hardenite, and vanadium cementite. Vanadium hardenite seems to have a hardness of 8 (topaz) as compared with the hardness 7 (quartz) of iron hardenite.

The recalescence results obtained are of great practical, as well as theoretical, interest. They strongly suggest the explanation of the curious thermo-mechanical behaviour of high-speed steels, and incidentally they appear provisionally to prove that the hardening is not due to allotropic change, but to the carbon change only. Fig. 7 shows (1) the inverse rate recalescence curve of a 0·2 per cent. plain carbon steel, which exhibits all Osmond's critical points, viz., Ar_3, Ar_2 (with a double peak) and Ar_1, the carbon change point; (2) the recalescence of a saturated steel containing 0·89 per cent. of carbon, in which all three points are merged into one very large evolution of heat at 695° C.; (3) the recalescence curve of a steel containing 1·1 per cent. of carbon, and 10·3 per cent. of vanadium. This curve was registered from 1210° to 505° C. It presents only the double-peaked point Ar_3. When the steel is quenched all along the above range it still remains quite soft to the file. To harden it it is necessary before quenching in water to heat the alloy above the A_1 or carbon change point, which takes place at a white heat, near 1400° C. The steel is then very hard.

Fig. 8 shows the transformation on heating up to a white heat (*a*) of annealed vanadium cementite into vanadium pearlite, (*b*) or sorbitic vanadium pearlite into amorphous and topaz-hard vanadium hardenite.

The advance in concrete cutting efficiency of turning tools from 1740 to 1912 was then dealt with. It

should be noted that the best steel of this kind made in Sheffield in 1740 would be absolutely incapable of cutting at all under conditions under which the best modern high-speed steel would remove 700 cubic inches of metal before breaking down.

The advantages of this enormous increase in cutting power are manifold, and an obvious example is the relative rapidity with which huge naval guns may now be turned out.

In January, 1909, I had the honour of suggesting to a Royal Institution audience the coming of a new British steel which would have a cutting power four times as great as the best steel then on the market. The skilful application of vanadium by Sheffield steelmakers has practically fulfilled that forecast, and the world-wide sensation and publicity created by the announcement has left Great Britain supreme in this very important branch of scientific steel metallurgy. An aspect of iron and steel metallurgy already demanding attention is the diminishing quantity of the world's iron ore supply. To a great extent the latter could be strongly reinforced from the huge deposits of iron sands now lying useless if a simple, economical and direct process of reduction could be devised. That metallurgical science and art will do this eventually seems certain, and I hold an opinion, founded on practical data, that the solution of this hitherto baffling problem is nearer than most metallurgists suppose.

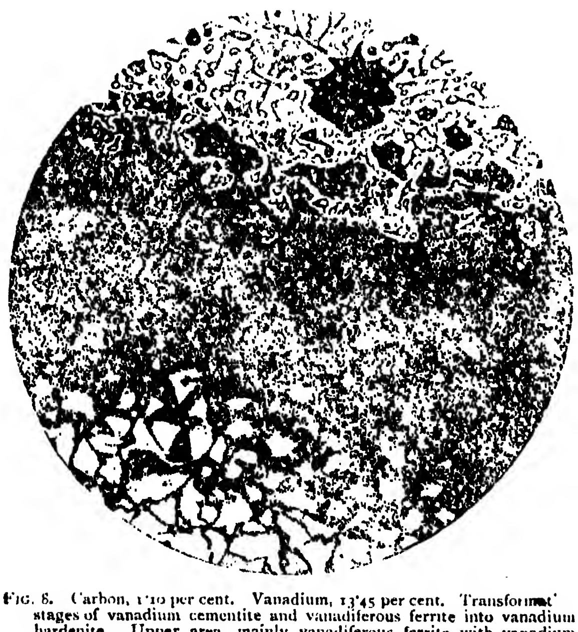


FIG. 8. Carbon, 1·10 per cent. Vanadium, 13·45 per cent. Transformat' stages of vanadium cementite and vanadiferous ferrite into vanadium hardenite. Upper area, mainly vanadiferous ferrite with vanadium cementite nodules, together with a little sorbitic vanadium pearlite. Middle area, ground mass of unsaturated vanadium pearlite, overlaid with undissolved nodules of vanadium cementite. Lower area, mainly structureless vanadium hardenite cells formed from a series of centres and surrounded by walls of the structure described for middle area Hardening temperature, near 1400° C. Magnified 450 diameters.

In conclusion, it may be pointed out that the skeleton history of early Sheffield steel metallurgy sketched in this discourse is in some important points in conflict with the somewhat disparaging historical outline written by Lord Macaulay, but in this particular connection there seems to be a modicum of truth in the answer of the schoolboy who, when asked to mention his favourite work of fiction, unhesitatingly replied, "Macaulay's History of England."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DURHAM.—ARMSTRONG COLLEGE.—The foundation-stone of the new building for the department of agriculture is to be laid on Saturday, April 5. Mr. C. Cochrane has promised the sum of 2,500*l.* towards the equipment of the department, and a Diesel engine has been offered to the college by Mr. G. E. Henderson. The appointment has been approved of Mr. G. D. H. Cole as deputy professor of philosophy, in the absence of Prof. Hoernlé, who is to deliver a course of lectures at Harvard University between October, 1913, and January, 1914.

THE Senate of the University of Dublin has approved the conferment of the honorary degree of doctor of science upon Prof. A. C. Seward, F.R.S., and Prof. the Hon. R. J. Strutt, F.R.S.

BY the will of Sir Alfred Jones, 227,100*l.* is left to charitable and educational institutions, and the scheme for carrying out the objects of the will has just been sanctioned by Vice-Chancellor Dudley Stewart-Smith. By the provisions of the will the Liverpool School of Tropical Medicine will receive 40,000*l.*, and a further 40,000*l.* when the annuities payable out of the estate cease. The 40,000*l.* now given is to form a fund to be called the "Sir Alfred Lewis Jones Bequest," and is to be devoted (*a*) to defraying the cost of a new wing or ward to the Liverpool Royal Infirmary for the reception of persons suffering from tropical diseases, to be called the "Sir Alfred Lewis Jones Tropical Ward"; (*b*) to the erection of new premises in Liverpool for the study of tropical medicine, to be permanently associated with the name of the testator; (*c*) to the erection and equipment of a laboratory in Sierra Leone, to be called the "Sir Alfred Lewis Jones Tropical Laboratory"; (*d*) the residue of the gift is to be used as a permanent endowment. 20,000*l.* is left for the promotion of technical education in British West Africa, and 1000*l.* to Liverpool University.

BY the will of Mr. John Fritz, the iron master, says *Science*, his residuary estate, amounting to about 30,000*l.*, is given to Lehigh University primarily as an endowment fund for the maintenance of the Fritz Engineering and Testing Laboratory. It is also announced that Mr. Charles L. Taylor, of Pittsburg, has given Lehigh University a gift for a large gymnasium and a stadium. From the same source we learn that by the will of the late Mr. C. C. Weld, of Newport, R. I., the residuary estate, valued at nearly 800,000*l.*, is, in case his daughter dies without issue, to be divided between the Massachusetts General Hospital and the Massachusetts Institute of Technology.

AT the opening of a new technical college and secondary school at Workington last week, Sir John Randles said he desired to commemorate the occasion by a gift of 1000*l.*, to provide a travel scholarship for a student of the college. The gift will yield some 50*l.* or 60*l.* each year to a student to assist him to become proficient in the metallurgy of iron and steel, which is associated with the local industry. The money is to be used by the student, within three years of its being awarded, in visiting some Colonial or foreign metallurgical centre, and may be recreative as well as useful. In this way Sir John Randles hopes some of the pleasure he has enjoyed in life by travel will be secured year by year to a Cumberland youth.

THE President of the Board of Education, Mr. J. A. Pease, spoke at a meeting of the National Union of Teachers at Sheffield on March 15, and referred to the

...tentions of the Government with regard to education. He said the Government are not pledging themselves to carry an Education Bill this session; their proposals are to be placed before the House of Commons with a view to their discussion. In the next session of Parliament it is hoped to pass the proposals—with such alteration as may have been thought expedient—into law. It is proposed to add considerably to the powers that local authorities already possess in educational affairs. The Government wish to induce everybody to cooperate so as to make the boy and girl better fitted to render the best possible service to the State. They wish to bring the best brains to the top, and to provide for those not included in that category an education from which they will get most advantage in connection with the factories, or the workshops, or whatever vocation they adopt in after life. Account must be taken of the conditions of youth from the cradle up to the universities, and all the nation's educational energies must be marshalled on a strategic plan. The Government's scheme is not going to be limited to an attempt to solve what Mr. Pease believes to be an insoluble denominational problem. The general principle of the Government's scheme is to secure that the best brains of the whole community should get to the top, and to provide a general diffusion of knowledge, so that we shall possess an educated democracy.

LORD HALDANE is to speak on the educational proposals of the Government at a joint meeting of teachers in secondary and technical schools, to be held at the University of London, South Kensington, on Saturday, March 29. The meeting is organised by the Association of Assistant Masters in Secondary Schools. The headmaster of Eton will preside, supported by Mr. Arthur Acland, and the following resolutions will be submitted:—"That this meeting welcomes the announcement that the Government proposes to deal in the near future with the question of education; hopes that the State will leave to the schools all reasonable freedom in such matters as time-table, curriculum, and careful educational experiments; and, with the object of attracting into the schools a sufficient supply of able and efficient teachers, urges that the increase of salaries and the provision of an adequate pension scheme should be a first charge upon any further grants for secondary and technical education." "That this meeting is of opinion that no pension scheme for secondary and technical teachers in England and Wales can be considered adequate which does not provide benefits approximately equal to those now secured to Scottish teachers."

THE Institution of Mechanical Engineers has now established graduateship and associate membership examinations, and has published the rules which will govern the examinations. The institution has in this way decided to cooperate with other engineering societies in the endeavour to define and raise the status of the engineer. The examinations will be held in London twice annually, in April and October. The "graduate" is defined as a person, not under eighteen years of age, who has passed the graduateship examination or reached some exempting standard, and has satisfied the council that he has received or is receiving regular training as a mechanical engineer with the necessary practical and scientific experience. No person is to be elected a graduate after twenty-five years of age. The institution's examination for graduates covers English, elementary mathematics, and scientific knowledge, and matriculation and similar certificates exempt the candidate from the test. The associate membership examination is ordinarily for candidates from twenty-five to thirty years of age, and covers general, scientific, and technical knowledge. General knowledge includes an essay on some subject in literature, science, technology, or economics and workshop organisation; scientific knowledge is tested by papers in applied mathematics, physics, and chemistry; and a choice of two technical subjects must be made from seven specified. Several recognised examinations exempt candidates from the institution's associate membership examination, and for candidates over thirty years of age special arrangements are made.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 13.—Sir Alfred Kempe, vice-president and treasurer, in the chair.—A. **Mallock**: A simple method of finding the approximate period of stable systems.—Prof. J. S. **Townsend** and H. T. **Tizard**: The motion of electrons in gases.—Prof. T. R. **Lyle**: The self-inductance of circular coils of rectangular section.—Dr. A. E. H. **Tutton**: Ammonium ferrous sulphate and its alkali-metal isomorphs. The author has added this salt to the thirty-six salts of the series

$$R_2M\left\{\begin{matrix}S\\SeO_4\\Cr\end{matrix}\right\}_2\cdot 6H_2O$$

which he has previously investigated in a detailed manner, both morphologically and optically.—H. **Thirkill**: The re-combination of the ions produced by Röntgen rays in gases and vapours. Measurements, under widely varying conditions, of the coefficient of re-combination of the ions produced by Röntgen rays in gases and vapours have yielded the following results:—(1) Re-combination seems to take place according to the simple law $dn_1/dt = dn_2/dt = -\alpha n_1 n_2$. (2) For a certain range of pressure, the coefficient of re-combination is proportional to the pressure.—Dr. W. **Wahl**: Optical investigation of solidified gases. III., The crystal-properties of chlorine and bromine. Crystallised chlorine and crystallised bromine are rhombic. Bromine is strongly pleochroic; chlorine less so. The absorption diminishes strongly when the temperature is lowered. The existence of a complete analogy in the crystalline characters of chlorine, bromine, and iodine has been established.—F. B. **Pidduck**: The abnormal kinetic energy of an ion in a gas. The abnormal rate of diffusion of negative ions in dry air, investigated by Townsend, would be explained if the negative ions had a velocity of agitation in excess of that of an equal number of molecules of the gas. The present paper investigates this from the point of view of the kinetic theory of gases.

Geological Society, February 26.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. C. A. **Matley**: The geology of Bardsey Island (Carnarvonshire), with an appendix on the petrography by Dr. J. S. **Flett**. Bardsey, an island a mile and three-quarters long, lies off the promontory of the Lleyn (western Carnarvonshire), and forms the isolated extremity of the strip of pre-Cambrian rocks that borders the western coast of the Lleyn from Nevin south-westwards. The rocks are principally gritty schistose slates, with many thin and some thick bands of grit, quartzite, and limestone; and they contain an horizon of variolitic lava and tufaceous shale, which indicates that a volcanic episode took place during their formation. Sills of albite-diabase also occur, as well as one or more sills of a crushed granite.—E. B. **Bailey**: The Loch Awe syncline (Argyllshire). This syncline is a comparatively shallow trough, with well-marked fan-structure due to small-scale isoclinal folding, in which the limbs of the folds are vertical along the axial

belt of the syncline, and inclined outwards on either side.

Physical Society, February 28.—Prof. A. Schuster, F.R.S., president, in the chair.—Prof. C. G. **Barkla** and G. H. **Martyn**: The authors have made a preliminary investigation of the Röntgen radiation proceeding from a crystal of rock salt (which is of the simple cubical form) when a pencil of Röntgen radiation is incident in a direction nearly grazing one of the three sets of mutually perpendicular cleavage planes. Reflection of X-rays by the cleavage planes.—Using a very narrow pencil of radiation, it was seen that the principal secondary pencil was one obeying the laws of reflections from the cleavage planes. A pencil diverging in all directions from a point source produced a corresponding reflected pencil of radiation converging to a line focus after reflection from a set of parallel cleavage planes. The quality of the radiation forming the secondary pencils was shown both by the photographic and by the ionisation method to be, not the fluorescent X-radiation, but of the kind previously described as scattered X-radiation. It was approximately of the same penetrating power as the primary radiation, and was approximately homogeneous, having traversed 5 mm. of rock salt in the case investigated. Interference fringe systems.—A diverging pencil of radiation was directed on to a crystal so that various portions were incident on the cleavage planes at different angles. A photographic plate showed the relative intensity of the corresponding reflected radiations. It was seen that the intensity of the reflected pencil varied periodically with varying angle of incidence, the maximum being separated by intervals corresponding to approximately equal increments in the value of $\cos\theta$, where θ was the angle of incidence on the reflecting planes. Such a series of maxima may be explained by interference of the pencils reflected from equal spaced parallel planes, the maxima being spectra of various orders. The wave-length, calculated on the assumption that these are planes passing through corresponding portions of molecules in the planes of cleavage, and that a molecule is simply NaCl, is found to be $0{\cdot}6 \times 10^{-9}$ cm. If the molecule be more complex, the calculated wave-length would be greater. This value thus agrees remarkably well with the value (between 1 and 2×10^{-9} cm.) calculated from the velocity of ejection of electrons by this X-radiation, taking this to behave as ultra-violet light of short wave-length. There can be little doubt that the fringe systems are interference fringe systems. That the smaller system is a series of spectra of different orders and the other an interference band system seems probable; this theory certainly explains the results observed up to the time of writing.—Prof. E. **Wilson**: Alternating-current magnets. It follows from the well-known law of pull of an electromagnet that if the magnetic field alternates between positive and negative values the pull is undirectional and intermittent. Unless means are provided to reduce the consequent chattering and vibration, the magnet is rendered useless. In the present experiments a phase-splitting device has been adopted, and consists in surrounding a portion of the pole-piece of the magnet with a short-circuited coil. The portion of the pole-piece so surrounded is sometimes said to be "shaded," and the coil referred to as a "shading" coil. The effect of this coil is to alter, not only the relative amplitudes, but the phase of the magnetic fields passing through the shaded and unshaded portions of the pole-face.

Linnean Society, March 6.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Geoffrey **Smith**: The development and inheritance of sexual characters. (Discussion.)

Zoological Society, March 4.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—Dr. F. E. **Beddard**: The anatomy and systematic arrangement of the Cestoidea. A new genus of tapeworms, of the family Ichthyotæniidæ, from the crossed viper (*Lachesis alternans*), was described.—Dr. W. A. **Cunnington**: The Branchiura collected by the third Tanganyika expedition in 1904–5. The collection contained more than 300 specimens, and proved that in the case of this group of animals also, Lake Tanganyika exhibits a number of endemic forms. While two species of Argulidæ are known to be widely distributed in the lakes of Africa, they are associated in Nyasa with a single form peculiar to that lake, but in Tanganyika with no less than seven new types. Tanganyika is thus shown to possess not only a considerable number of characteristic species, but a much richer Branchiuran fauna than the other great African lakes. The paper was illustrated by lantern-slides made from photomicrographs of the new species.—W. **Schaus**: Descriptions of a large number of new species of Rhopalocera from Costa Rica. More than 100 species had been collected, and of these fifty-four were found to be new.—Dr. A. **Willey**: Notes on plankton collected across the mouth of the St. Croix River, New Brunswick, in July and August, 1912.

Mineralogical Society, March 11.—Prof. H. L. Bowman, vice-president, in the chair.—W. Campbell **Smith**: The mineral collection of Thomas Pennant (1726–98). The collection, which has recently been presented to the British Museum by the Earl of Denbigh, is accompanied by three volumes of manuscript catalogue written in 1757. The classification used in them is based, with some modifications, on Woodward's "Natural History of the Fossils of England," published in 1729. Special mention is made of specimens presented by Borlase, Pontoppidan, and da Costa, and the minerals from Flintshire were treated in some detail. Several specimens were described by Pennant in "A Tour in Wales."—Arthur **Russell**: The minerals and mineral localities of Montgomeryshire. Of the species described the more remarkable are aurichalcite, from Llanymynech Hill Mine, Llanymynech; harmotome in double twins, associated with barytes and witherite, from Cwm-orog Mine, Llangynog; hydrozincite, which forms a remarkable recent deposit on the sides of a level in the Van Mine, Llanidloes; pyromorphite from Aberdeunant Mine, Llanidloes, and Llanerch-yr-aur Mine, Llanbrynmair; witherite, from Cwm-orog Mine, Llangynog, Gorn Mine, Pen-y-gaer Mine, and Pen-y-clyn Mine, Llanidloes, the crystals from the last being noteworthy on account of the almost entire suppression of the alternate faces of the pseudo-hexagonal prisms and pyramids.—Dr. G. F. Herbert **Smith**: A new stereographic protractor. The novelty consists of a curved ruler, made up of a combination of springs, which sensibly retains a circular curvature within the limits for which it is required. At the centre of the arc it is clamped to an arm, movable in a groove and carrying a scale, from which the azimuth of the corresponding great circle may be read off. The other edge of the protractor carries the usual tangent scales, from which the position of the compass to draw any circle up to the one corresponding to the great circle making an azimuth of 50° with the equatorial plane may be determined. The scales are based upon a radius of 10 cm.—L. J. **Spencer**: A (sixth) list of new mineral names.

Royal Meteorological Society, March 12.—Mr. C. J. P. Cave, president, in the chair.—R. G. K. **Lempfert**: Weather forecasts: past and present. For the preparation of forecasts, information is now received at

he Meteorological Office each day by telegraph from hirty British stations, and from forty on the continent of Europe and the islands of the North Atlantic. Information from thirty stations is, however, quite inadequate for checking the accuracy of the forecasts. For this purpose results from more than 130 stations are used. The forecasts are checked separately for wind and weather, the term weather being considered in regard to (1) temperature; (2) precipitation; (3) cloudiness or the reverse; (4) fog. The extension of he period covered by the forecasts for "further outlook" was described, and the application of this to he notification of probable spells of fine weather which the Meteorological Office now issues to farmers during the summer.

Mathematical Society, March 13.—Prof. Love, president, in the chair.—H. M. **Macdonald**: The diffraction of light by an opaque prism.—S. **Lees**: The natural radiation from transparent media.—L. J. **Mordell**: Indeterminate equations of the third and fourth degrees. —A. **Cunningham**: Mersenne's numbers.—J. **Proudman**: (1) A two-dimensional potential problem with applications to hydrodynamics and elasticity; (2) tidal motion in rotating sheets of water.

Royal Astronomical Society, March 14.—Major E. H. Hills, C.M.G., F.R.S., president, in the chair.—H. F. **Newall** and F. J. M. **Stratton**: Enhanced lines in the early spectrum of Nova Geminorum No. 2. The elements most strongly represented by these lines are titanium and iron; a number of other elements were indicated with less certainty. Two well-known bands frequently ascribed to helium were considered by the authors to be enhanced lines of iron.—F. W. **Dyson**: The distribution in space of the stars of Carrington's circumpolar catalogue. This catalogue contains practically all the stars of the Bonn Durchmusterung within 9° of the north pole. The paper dealt at length with the proper motions of the stars, the proper motions being based on those determined in connection with the Greenwich astrographic work.—A. S. **Eddington**: The distribution in space of the bright stars. The stars considered were those brighter than 5·8 magnitude. Stars of the spectral types A and K were separately dealt with, and in each case results were obtained for two regions, one typical of high galactic latitudes and one of low.—Major **Hills** and F. C. H. **Carpenter**: Results of observations with the Durham almucantar during 1912. The results on the whole were not very encouraging, as there are two errors which are peculiar to all floating instruments—the temperature gradient and the unsteadiness of the telescope. These may be reduced, but it does not seem possible to eliminate them; the almucantar thus seems an inferior instrument to the transit circle. —R. S. **Capon**: Note on the possibility of refraction in the solar atmosphere (papers of the International Union for Solar Research, No. 8).

CAMBRIDGE.

Philosophical Society, February 10.—Dr. Shipley, president, in the chair.—G. R. **Mines**: Note on the respiratory movements of *Torpedo ocellata*. A method for recording the frequency and amplitude of rhythmic movements over prolonged periods of time is described. The respiratory movements of elasmobranch fishes are known to be of two kinds; the ordinary breathing movements interrupted by occasional "spouting movements." The spouting movements can be produced with ease by the slightest irritation of the inside of the pharynx, as by the introduction of foreign particles with the water. It has therefore been supposed that whenever the spouting movements are observed they indicate the entry of some foreign object with the inspired water. Experiments made with the apparatus referred to above show that the spouting movements have a tendency to recur at rhythmic intervals. The period of this rhythm is often as long as two to five minutes, but sometimes it is shorter. The modifications it undergoes in response to changes in the environment suggest that the nerve cells controlling the movements have themselves a tendency to discharge rhythmically.—F. A. **Potts**: The swarming of Odontosyllis. The appearance of great numbers of sexually mature individuals of *Odontosyllis phosphorea* was observed on the surface of the sea near Nanaimo, Vancouver Island, in the years 1911 and 1912, during four days in the latter part of August. The swarming begins before sunset, lasts nearly an hour, and is almost over before it is quite dark. A comparison was drawn with *O. enopla* from the Bermudas, described by Galloway and Welch, in which the time of swarming is a little later and phosphorescence is so greatly developed as to be used as a method of sexual recognition. Only in the case of the insects elsewhere has luminosity been proved to possess an adaptive significance.—S. R. **Price**: Observations on *Polyporus squamosus*. *Polyporus squamosus*, Huds., is a well-known timber-destroying fungus, frequent on many species of our trees. The artificial culture of the fungus on sterilised wood blocks was described for the first time.—R. H. **Rastall**: Note on the composition of some Pleistocene sands near Newmarket.

MANCHESTER.

Literary and Philosophical Society, February 18.—Prof. F. E. Weiss, president, in the chair.—Prof. G. Elliot **Smith**: The Sussex skull and its brain-cast. Plaster copies were shown of the fragments of the Sussex skull and the cast made from them to represent the formation of the brain. An account of our present knowledge of ancient man was given in order to illustrate the importance of the new information supplied by the Sussex remains.

March 4.—Prof. F. E. Weiss, president, in the chair.—A. D. **Hall**: The plant and the soil. The plant takes but a very small portion of its substance out of the soil, but that little is indispensable. Growth especially depends upon the supply of nitrogen, phosphoric acid, and potash, and the function of a manure is to supply the deficiencies of an ordinary soil in one or more of these substances. These substances having to be in solution before entering the plant, one had to conceive of the water which is always present in the soil in a thin film coating the soil particles as a nutrient solution containing more or less of the materials determining the plant's rate of growth. Compounds of phosphoric acid and potash present in the soil possess but a very slight solubility, and the soil solution would become saturated to its utmost capacity even though the soil contained much less phosphoric acid and potash than are ever found in cultivated land. The acceptance of this view prevents the difference between good and bad soil being attributed to any difference in the amount of phosphoric acid and potash in the soil; moreover, additions of these substances could not directly stimulate the nutrition of the plant. This hypothesis had then to face the well-known fact that the yield of crops on particular soils could be greatly increased by certain manures, namely phosphates. American investigators propounding this theory suggest that the manure acts by precipitating and putting out of action certain injurious substances excreted by the roots of the plants. The value of proper aeration of roots was demonstrated, and results of wheat- and barley-growing experiments given. The theory of the indifference of the plant to the amount of nutrients in the soil was found to be untenable.

EDINBURGH.

Royal Society, February 17.—Dr. Horne, F.R.S., vice-president, in the chair.—Helen **Pixell**: Polychæta of the families Serpulidæ and Sabellidæ, collected by the Scottish National Antarctic Expedition. Eight genera were represented in the collection, including four new species, one in Apomatus, two in Spirorbis, and one in Potamus.—Dr. J. R. **Milne** and H. **Levy**: The recording of fluctuating flow: its difficulties and errors. Owing to the inertia of its moving parts, any instrument employed to record either "instantaneous values" or the "time integral of a fluctuating quantity" is liable to err. The extent of this error is in many cases unknown, *e.g.* in the case of a Robinson cup anemometer; and the present paper describes some experiments made with an analogous instrument to elucidate the matter. From the results obtained it appears that fluctuation in the flow causes the instrument to read too high.

March 3.—Prof. Bower, F.R.S., vice-president, in the chair.—Dr. R. A. **Houstoun**, A. H. **Gray**, and C. **Cochrane**: The absorption of light by inorganic salts (three concluding papers of a series). No. IX. dealt with salts of copper, cobalt, and nickel dissolved on alcohol and acetone, and described a successful attempt to apply the mathematics of mass action to the change of colour in an alcoholic solution of cobalt bromide when water was added. No. X. was occupied more particularly with the bearing of new methods on the old controversy of the colour of the ions, and it was shown conclusively that the colour changes of the cobalt, nickel, and copper salts have nothing whatever to do with ionisation. In No. XI. Dr. Houstoun discussed the theoretical aspect of the results gained and the present state of research in the field.—Dr. G. A. **Carse**, G. **Shearer**, and H. **Jameson**: Note on a comparison of records of atmospheric potential at two stations in Edinburgh. The two stations were the Physical Laboratory of the University and the Royal Observatory, Blackford Hill. A large number of records were compared, and the curves for the two stations showed in general good agreement, the agreement being best in those which indicated a disturbed state of the atmosphere. This is interesting when it is considered that the University is in the centre of the town and the observatory in the clearer air of the outskirts, nearly two miles distant.

DUBLIN.

Royal Dublin Society, February 25.—Prof. J. Wilson in the chair.—Dr. G. H. **Pethybridge**: The rotting of potato tubers by a new species of Phytophthora having a method of sexual reproduction hitherto undescribed. A new form of rot in potato tubers is described, in which the cut surface of affected tubers when exposed to air turn at first pink and afterwards nearly black. The causative organism is a new species of Phytophthora, to which the name *P. erythroseptica* is given. Sexual organs are produced when the fungus is grown artificially as a saprophyte, and probably also in nature. At an early stage in its development the young oogonium penetrates the antheridium at or near the base of the latter, grows up through it, bursts out at the summit, where it swells to form the oogonium proper, in which the oosphere and oospore develop. Fertilisation, if it takes place at all, probably occurs while the oogonial incept is within the antheridium, and hence before the formation of the oosphere. The sexual organs of *P. Phaseoli*, *P. infestans*, and probably *P. omnivora*, var. *Arecae*, are developed in a similar manner, but those of *P. cactorum*, *P. fagi*, *P. Syringae*, and probably others, follow the usual course, where the antheridium penetrates the oogonium laterally. Species which follow this latter method are removed from the genus Phytophthora and are placed in a new one, to which the name Nozemia is given.—Dr. G. H. **Pethybridge** and P. **Murphy**: Pure cultures of *P. infestans*, de Bary, and the development of oospores. An account is given of the cultivation of *P. infestans* as a saprophyte on various media, on some of which (Oat-Agar and Quaker Oat-Agar) sexual organs are developed. Clinton's discovery of undoubted oospores is confirmed, and the mode of their formation is explained by the process occurring in *P. erythroseptica*.—Prof. J. **Wilson**: Inter-alternative as opposed to coupled Mendelian factors: a solution of the agouti-black colour in rabbits. This is an alternative solution to that given by Prof. Punnett in the November (1912) number of *The Journal of Genetics* as to the agouti-black colour in rabbits. Prof. Punnett found three factors acting conspicuously. On the "presence and absence" theory each of these must have its "absence." Thus there were six in all, and to make the case two of the three prominent factors had to be coupled. The author finds that there are five factors operating in the case, viz. three dominants and two recessives, but that two of the dominants, and one of the recessives are inter-alternatives—that is, any one of the three can alternate with either of the other two, just as happens with the black, white, and red colours of cattle, or with the colours of horses.—E. W. **Fenton**: Notes on recent pampa and other formations in Patagonia. The author, from his traverses in southern Patagonia, brings forward evidence of widespread glacial and ice-sheet conditions at the close of Pliocene times, followed by a long inter-glacial interval, during which extensive outpourings of lava and emission of exploded materials occurred. This interval, which may have lasted for some thousands of years, was followed by a more local glaciation when the Andes sent glaciers into the lowlands. The author believes that elevation of the area is now in progress.

PARIS.

Academy of Sciences, March 3.—M. F. Guyon in the chair.—B. **Baillaud**: The publication of certain works of the Paris Observatory.—A. **Lacroix**: The mineralogical constitution of the Los Archipelago (Guinea).—Paul **Sabatier** and A. **Mailhe**: A catalytic method of isomerising the alkyl chlorides and bromides. Chloride of barium or chloride of thorium at 250° C. decompose the alkyl chlorides and bromides into acid and ethylenic hydrocarbon. If this mixture is passed over pumice in the same tube heated to 200° C. these gases re-combine, giving secondary and tertiary alkyl halides. Examples of the application of the method are given.—Charles **Depéret**: Observations on the Pliocene and Quaternary geological history of the Gulf and Isthmus of Corinth.—M. **Barbier** was elected a correspondant for the section of chemistry in the place of the late M. Ladenburg.—Charles **Nordmann**: The light yield of a black body at high temperatures and on that of the stars. First application to Arcturus and Vega. By the application of Planck's and Stefan's laws it is shown that the light yield of a radiating body increases with the temperature to a maximum and then decreases. As a first approximation this temperature is found to be 6430° C., very nearly that found by various methods for the sun. The effective temperature of Arcturus is deduced at 3400° C., and Vega is 2·2 times as great.—M. **Tzitzeica**: Derived reciprocal networks.— J. Le **Roux**: The determination of the harmonic functions. Application to the square.—Mlle. Th. **Tarnarider**: The best approximation of $|x|^{2s+1}$ by polynomials of indefinitely increasing degrees.—Jacques **Chapelon**: The numbers of classes of positive binary quadratic forms

—Et. **Delassus**: The equilibrium and small movements of systems submitted to linkages of any order whatever.—André **Blondel**: The internal power and synchronising couple of synchronous alternators working on a network at constant potential or in parallel.—Casimir **Cépède**: A new method of mounting microscopic preparations permitting the study of both faces of the section under the strongest magnifications, and doing away with the necessity of special methods of packing. A hole is bored in the glass slide in such a manner that the object can be imbedded between two cover glasses. This allows either side to be examined, and the slides can be packed vertically in contact with each other without danger of damaging the section.—Pierre **Goby**: A new application of the X-rays: microradiography. The apparatus described and figured gives an enlarged radiogram of small objects. Illustrations are given of radiograms from twelve to seventeen times the diameter of the original objects.—G. **Reboul**: Capillary phenomena in gases. Extension of the Laplace formula to solid-gas contact.—Marcel **Boll**: The energy absorbed and mass formed in a photochemical reaction. A study of the conductivity of a very dilute solution of chloroplatinic acid under the influence of a monochromatic radiation.—André **Kling** and D. **Florentin**: The action of low temperatures on explosives. The handling and opening of explosive bombs has frequently to be undertaken in the Paris Municipal Laboratory, and experiments have been made to see if the force and velocity of detonation of various explosives can be reduced by cooling to the temperature of liquid nitrogen. It has been found that the sensibility of some explosives and detonators is reduced by cooling, but when explosion takes place the force of the explosion is not affected by the low temperature.—Victor **Henri** and Marc **Landau**: Study of the absorption of the ultra-violet rays by acetylene. Tables are given showing the positions of the bands produced by the gas and by its solutions.—Witold **Broniewski**: The critical points of iron. Heating curves are given for electrolytic iron and also the results of measurements of the thermo-electric power, electrical resistance, expansion, and thermal points.—L. **Guillet** and A. **Portevin**: Some properties of a commercial electrolytic iron. In this metal no carbon, manganese, silicon, or sulphur could be detected. It contained phosphorus 0·025 per cent., and arsenic 0·011 per cent. Determinations were made of its critical points, and two microphotographs are reproduced.—H. **Pélabon**: Study of the system antimony sulphide, lead sulphide. Definite compounds were shown by the existence of transition points and confirmed microscopically.—Daniel **Berthelot** and Henry **Gaudechon**: A levulose actinometer for ultra-violet light. The influence of the concentration on the velocity of the photochemical reaction. In weak solutions the absorption is slight and is proportional to the concentration; in concentrated solutions the absorption is total, and does not increase with the concentration.—MM. **Lespieau** and **Bresch**: The action of α-β-dichlorethyl ether on mixed magnesium derivatives.—Pierre **Jolibois**: Methyl-magnesium iodide. By the action of heat on methyl-magnesium iodide a substance is obtained of the composition MgI_2,Mg_2C. This is attacked by water, nearly pure methane being evolved.—André **Meyer**: "Halochromy" in the derivaties of phenylisoxazolone and in its indogenides.—Albert **Michel-Lévy**: The eruptive rocks of the Lyonnais.—M. **Mazé**: The relation which exists between the water evaporated and the weight of plant material elaborated by maize.—Eug. **Rousseaux** and Maurice **Sirot**: Soluble nitrogenous material as a factor in valuing flour. In a good flour the ratio between the total nitrogen and the soluble nitrogen should not fall below a certain figure. A low ratio corresponds with bad bread-making properties.—A. **Demolon**: Researches on the fertilising action of sulphur. The fertilising action of sulphur may be attributed to its action on the micro-organisms of the soil and also to its progressive oxidation to sulphuric acid.—L. C. **Soula**: The activity of the nervous centres and nitrogen catabolism of the nerve substance.—Raphael **Dubois**: The nature and development of the light organ of *Lampyris noctiluca*.—Gabriel **Bertrand** and H. **Agulhon**: The presence of boron in the animal kingdom. The authors conclude that boron exists normally in very small proportions in all animals. The amount is greatest in animals of madine origin.—Henri **Stassano**: Contribution to the knowledge of the plasma of propeptone.—H. **Maurice**: The results given by captive balloons north of the polar circle. Temperatures are given on the ground and at varying heights up to 20,000 metres.—E. A. **Martel**: Study of the temperatures of subterranean waters.

BOOKS RECEIVED.

Household Bacteriology for Students in Domestic Science. By E. D. Buchanan and Prof. R. E. Buchanan. Pp. xv+536. (London: Macmillan and Co., Ltd.) 10*s.* net.

Bücher der Naturwissenschaft. Band 15, Vom Keim zum Leben. By Prof. K. Lampert. Pp. 198+xii plates. (Leipzig: P. Reclam, jun.) 1 mark.

Government of India. Department of Revenue and Agriculture. Agricultural Statistics of India for the Years 1906–7 to 1910–11, in 2 vols. Vol. ii., Native States. Pp. 123. (Calcutta: Superintendent Government Printing, India.) 1*s.* 6*d.*

Garden Work: a Practical Manual of School Gardening. By W. Good. Pp. xvi+399+plates. (London: Blackie and Son, Ltd.) 3*s.* 6*d.* net.

Die Methoden der exakten, quantitativen Bestimmung der Alkaloide. By Prof. A. R. von Korczynski. Pp. iv+82. (Berlin: Gebrüder Borntraeger.) 3.50 marks.

Osmotic Pressure. By Prof. A. Findlay. Pp. vi+84. (London: Longmans and Co.) 2*s.* 6*d.* net.

Report of the Librarian of Congress and Report of the Superintendent of the Library Building and Grounds for the Fiscal Year Ending June 30, 1912. Pp. 235. (Washington: Government Printing Office.)

The Mosquitoes of North and Central America and the West Indies. By L. O. Howard, H. G. Dyar, and F. Knab. Vol. i., A General Consideration of Mosquitoes, their Habits, and their Relations to the Human Species. Pp. vii+520. Vol. ii., Plates. Pp. x+150 plates. (Washington: Carnegie Institution.)

Carnegie Institution of Washington. Year Book. No. 11, 1912. Pp. xvi+294. (Washington: Carnegie Institution.)

The Classics of International Law. Edited by J. B. Scott. De Jure Belli ac Pacis Libri Tres, in quibus Ius Naturæ and Gentium, item Juris Publici prœcipua explicantur. By H. Grotius. Vol i., Reproduction of the Edition of 1646. Pp. 618. (Washington: Carnegie Institution.)

Researches of the Department of Terrestrial Magnetism. Land Magnetic Observations, 1905–1910. By L. A. Bauer. Pp. iv+185. (Washington: Carnegie Institution.)

The Vulgate Version of the Arthurian Romances. Edited from Manuscripts in the British Museum by H. O. Sommer. Vol. vi. Pp. 391. (Washington: Carnegie Institution.)

The Nummulosphere: an Account of the Organic Origin of so-called Igneous Rocks and of Abyssal

Red Clays. By R. Kirkpatrick. Pp. 104+2 plates. (London: Lamley and Co.) 2s. net.

V. v. Richter's Chemie der Kohlenstoffverbindungen oder Organische Chemie. Elfte Auflage. Zweiter Band. By Drs. R. Anschutz and H. Meerwein. Pp. xxii+1048. (Bonn: F. Cohen.) 26 marks.

A Guide for Laboratory Geography Teaching, for Use in connection with "A Laboratory Manual of Physical and Commercial Geography," by the late Prof. R. S. Tarr and Dr. O. D. von Engeln. By Dr. O. D. von Engeln. Pp. iii+20. (London: Macmillan and Co., Ltd.) 1s. net.

Elementary Principles of Electricity and Magnetism for Students in Engineering. By Drs. R. H. Hough and W. M. Boehm. Pp. vii+233. (London: Macmillan and Co., Ltd.) 6s.

Garden Flowers as They Grow, Photographed in Colour Direct from Nature. By H. S. Corke, with descriptive text by H. H. Thomas. Pp. iii+197. (London: Cassell and Co., Ltd.) 5s. net.

Heat: a Manual for Technical and Industrial Students. By J. A. Randall. Pp. xiv+331. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 6s. 6d. net.

Cambridge County Geographies:—Herefordshire. By A. G. Bradley. Pp. xi+149. (Cambridge University Press.) 1s. 6d.

University of Calcutta Readership Lectures. Matrices and Determinoids. By Prof. C. E. Cullis. Vol i. Pp. xii+430. (Cambridge University Press.) 21s. net.

Abhandlungen und Vorträge zur Geschichte der Naturwissenschaften. By Prof. E. O. von Lippmann. Zweiter Band. Pp. x+491. (Leipzig: Veit and Co.) 8 marks.

Brands Used by the Chief Camel-Owning Tribes of Kordofán. By H. A. MacMichael. Pp. vii+40+xvii plates. (Cambridge University Press.) 6s. net.

Die Mathematischen Wissenschaften. Erste Lief. Die Mathematik im Altertum und im Mittelater. By H. G. Zeuthen. Pp. iv+95. (Leipzig and Berlin: B. G. Teubner.) 3 marks.

The Fitness of the Environment. By Prof. L. J. Henderson. Pp. xv+317. (London: Macmillan and Co., Ltd.) 6s. 6d.

"Red Books" of the British Fire Prevention Committee. No. 174, Fire Tests with Roof Coverings of Asbestos Cement Corrugated Sheets. Pp. 31. (London: British Fire Prevention Committee.) 2s. 6d.

A Text-Book on Field Fortification. By Col. G. J. Fiebeger. Third edition. Pp. xii+155+xxvii plates. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 8s. 6d. net.

A Text-Book of Experimental Metallurgy and Assaying. By A. R. Gower. Pp. xiv+163. (London: Chapman and Hall, Ltd.) 3s. 6d. net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College for the Years 1905–1912.—Edited by R. M. Milne. (London: Macmillan and Co., Ltd.) 6s.

Catalogue of the Heads and Horns of Indian Big Game, bequeathed by A. O. Hume, C.B., to the British Museum (Natural History). By R. Lydekker. Pp. xvi+45. (London: British Museum (Natural History); Longmans and Co., and others.) 2s.

A Revision of the Ichneumonidæ, based on the Collection in the British Museum (Natural History), with Descriptions of New Genera and Species. Part ii. By C. Morley. Pp. x+140+plate. (London: British Museum (Natural History); Longmans and Co., and others.) 5s. 6d.

A Descriptive Catalogue of the Marine Reptiles of the Oxford Clay, based on the Leeds Collection in the British Museum (Natural History). Part ii. By Dr. C. W. Andrews. Pp. xxiv+206+xiii plates. (London: British Museum (Natural History); Longmans and Co., and others.) 25s.

Moderne Probleme der Biologie. By Prof. C. S. Minot. Pp. vi+111. (Jena: G. Fischer.) 3 marks.

Die Weltherrin und ihr Schatten. By F. Auerbach. Zweite Auflage. Pp. 74. (Jena: G. Fischer.) 2 marks.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. (New Series.) No. 57, Studies on the Flagellates of the Genera Herpetomonas, Crithidia, and Rhynchoidomonas. No. 1. By Capt. W. S. Patton. Pp. 21+plate. No. 58, Studies on the Mouth Parts and Sucking Apparatus of the Blood-sucking Diptera. No. 2. By Capt. F. W. Cragg. Pp. 33+plate. No. 59, ditto. No. 3. By Capt. F. W. Cragg. Pp. 36+vi plates. (Calcutta: Superintendent Government Printing, India.) 1s. 2d., 1s., and 1s. 11d. respectively.

DIARY OF SOCIETIES.

WEDNESDAY, MARCH 26.

AERONAUTICAL SOCIETY, at 8.0.—Annual General Meeting, 8.30.—Hydro-Aëroplanes: Commander C. R. Samson, R.N.

THURSDAY, MARCH 27.

CONCRETE INSTITUTE, at 7.30.—Beams and Props for Mines: Prof. S. H. Dixon.

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FOREST PHYSIOGRAPHY.

Physiography of the United States and Principles of Soils in Relation to Forestry. By Dr. I. Bowman. Pp. xxii+759. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1911.) Price 21s. net.

AS the longer title of this work denotes, this is not a book on forestry, but on physiography for students of forestry, and especially for those of the United States. The book is in two parts, the first of which forms a complete treatise on the subject of soils, and it is this part which will be of most interest to foresters and nature-students in this country. The second and larger part is devoted to a description of the United States, according to physiographic regions, in regard to geology, climate, soil, and vegetation.

In reading this book one cannot fail to be impressed by the prominence given to the question of water and water-supply. "Water constitutes from 65 per cent. to more than 95 per cent. of the tissues of plants," and "is the factor that most frequently conditions life and death." Water is also the natural force which is most capable of being controlled by man: by the preservation of soil-cover and by a proper system of drainage promoting its beneficial influences and checking its dangers. In this connection Fernow is quoted as saying:

"The leaf canopy catches and re-evaporates about 12 per cent. of the rainfall, while 10 per cent. of it runs along the tree-trunks and reaches the ground by a circuitous course. The forest litter, the moss-covered and leaf-strewn ground, is capable of absorbing water at the rate of 40,000,000 to 50,000,000 cubic feet per square mile in ten minutes—water whose progress is delayed by some twelve to fifteen hours after the first effects of a heavy freshet have passed."

The author deplores the reckless timber-cutting which has taken place in America during the last twenty-five years, with the result that the soil, "the inheritance of geologic ages," has in many cases been washed away or impoverished. In a striking paragraph, in dealing with the evil effects of deforestation in the southern Appalachians, he writes:

"The rain beats directly upon the soil, the retarding influence of the ground litter and tree-roots is withdrawn, and more rapid soil removal occurs. When once these evil effects have been allowed to take place, mankind is deprived practically for thousands and even millions of years of favourable conditions that preceded the epoch of destruction. In a hundred years man may achieve such baneful results as nature will compensate only during a geologic period of hundreds of thousands of years. Soil is a resource of priceless value. On resistant rocks its formation is excessively slow. Many glacial striæ formed on resistant rock during the last glacial epoch, roughly 60,000 to 75,000 years ago, are still preserved as fresh as if they were made but yesterday. In that time man has come up from the cave and the stone-hammer. Seventy thousand years is a very short time for the development of a soil-cover; for man it means a period so great that his mind can hardly appreciate it. The earth as we find it in the geologic to-day must be treated with care if the human race is to have a fair distribution of its wealth in time. To the geologic mind there is something shocking in the thought that a single lumber merchant may in fifty years deprive the human race of soil that required 10,000 years to form."

Although forests undoubtedly tend to regulate stream-flow, the author is careful to show that they are not an absolute preventive of flooding, and that in individual cases their influence may be quite insignificant. It is largely a matter of soil and situation, but where soil removal exceeds soil formation, or where the balance between the two is only delicately established, the destruction of forests can only be attended by disastrous consequences.

The chemistry of the soil, the effects of sun, air, wind, the beneficial influences of the lower forms of vegetable and animal life, are each dealt with in a concise though comprehensive manner, and frequent footnotes give authorities for statements made and references to further literature on the various points discussed.

A key-list giving the scientific names of the trees referred to by their common names would be of value, and there are a few minor errors which should be corrected in future editions.

The book is admirably produced, and fully illustrated by diagrams, maps, and photographs, and forms a most useful addition to the literature of the subject.

J. W. MACKAY.

THE HIGHWAY OF ANIMAL EVOLUTION.

The Evolution of the Vertebrates and their Kin. By Dr. William Patten. Pp. xxi+486; illustrated. (London: J. and A. Churchill, 1912.) Price 21s. net.

THE author presents in a stately form a detailed account of his theory of the Arachnid origin of vertebrates. He has worked at this persistently since 1884, and in the course of his investigations has made important contributions to our knowledge of Limulus and the Ostracoderms. No one will withhold admiration who looks into the details of comparative anatomy, histology, and embryology with which

this large and finely illustrated volume is filled, for Prof. Patten has spared no labour in his endeavour to test what seems to him to be an approximate solution of the problem of the evolution of the vertebrates. It may be said at the outset that his theory is quite different from Gaskell's, which, in his judgment, was vitiated by the assumption that the neural surface of an Arthropod is the same as the hæmal surface of a vertebrate.

The general thesis is that "the great Vertebrate-Ostracoderm-Arthropod phylum forms the main trunk of the genealogical tree." Vertebrates arose through Ostracoderms from Arachnid-like Arthropods. One of the important steps was cephalogenesis, numerous anterior metameres being integrated into a "head"—prophetic of the vertebrate head; the old mouth was closed and a new one opened; the bases of the more anterior appendages were forced towards the hæmal surface to form the vertebrate oral arches; the heart was drawn forwards; true gill-clefts appeared; the lateral eye placodes were transferred to the interior of the cerebral vesicle and the optic ganglia to the roof of the mid-brain; and so on.

The Arachnids' forebrain vesicle is formed like that of vertebrates; both have the same sort of pineal eye; Arachnids have a cartilaginous endocranium similar in shape and location to the primordial cranium of vertebrates, and they have an axial subneural rod comparable with the notochord; in Arachnids the brain contains approximately the same number of neuromeres as in vertebrates—these are fair illustrations of the arguments by which Prof. Patten supports his thesis. With his guiding idea of an Arachnid-Ostracoderm-Vertebrate alliance, Prof. Patten feels that the numerous resemblances he adduces have a cumulative convincingness. We must confess that many of them appear to us exceedingly far-fetched, *e.g.* that the "lemmatochord" is comparable to the notochord, and that many others, *e.g.* "endocranium" and cranium, simply illustrate convergence. To the preliminary objection that Arachnids are far too specialised to have given rise to vertebrates, the author gives an answer the point of which we cannot profess to see, that "every animal is a specialised one when compared with its ancestors, and at the same time a generalised one when compared with its descendants."

In regard to the position of other classes involved, Prof. Patten holds remarkable views. The Ostracoderms are intermediate between Arachnids and vertebrates; the Cirripedes are the only members of the Acraniates in which the more typical Arthropod characters are retained; the Tunicates are descended from that particular subdivision of the Arthropods to which the Cirripedes and Copepods belongs; the Echinoderms are also descended from Cirriped-like Arthropods, as may be inferred from the nauplius-like larval form; the Enteropneusta are probably descendants of primitive Arthropods; the Pterobranchs have in certain respects, such as the six pairs of appendages, a decidedly arachnoid character; the Polyzoa may best be interpreted as descendants of primitive Arthropods of the Cirriped type; the Chætognatha are unquestionably primitive Arthropods, somewhat degenerate. Thus we see how the clearing up of the main highway—the Arachnid-Ostracoderm-Vertebrate line—makes the relations of the byways plain! There is much to be said for vigorous heresy, but this is a perversion of morphology. We are minded, however, of the saying of another investigator of the pedigree of vertebrates, that "in morphology everything is important except the hypothesis." In conclusion, we may note that Prof. Patten's researches have made him a convinced "bathmist." "The internal processes of differential growth and readjustment are fundamentally important. Environmental influence, natural selection, and the like have played an insignificant subordinate part. "The creative power of internal environment is always present, always active, always changing." We confess to liking this view better than the author's phylogeny.

ZOOLOGY AND NATURAL HISTORY.

(1) *Animal Secrets Told: A Book of "Whys."* By H. C. Brearley. With twelve full-page illustrations from photographs by Elwin R. Sanborn. Pp. xvi + 274. (London: Headley Brothers, n.d.) Price 5s. net.

(2) *Wild Life in the West Highlands.* By C. H. Alston. With illustrations by A. Scott Rankin. Pp. xi + 271. (Glasgow: James MacLehose and Sons, 1912.) Price 6s. net.

(3) *The Sheep and Its Cousins.* By R. Lydekker, F.R.S. Pp. xv + 315. (London: George Allen and Co., Ltd., 1912.) Price 10s. 6d. net.

(4) *The Marine Mammals in the Anatomical Museum of the University of Edinburgh.* Part i., Cetacea; Part ii., Sirenia; Part iii., Pinnipedia. By Sir Wm. Turner, K.C.B. Pp. xv + 2[illegible]. (London: Macmillan and Co., Ltd., 1912.) Price 6s. net.

(5) *The Growth of Groups in the Animal Kingdom.* By Prof. R. E. Lloyd. Pp. viii + 185. (London: Longmans, Green and Co., 1912.) Price 5s. net.

"ANIMAL Secrets Told" (1) is a series of popular articles explaining, or attempting to explain, the reason for special variation in the

shape and structure of some of the external organs, like the feet, tail, ears, and noses, of certain selected types of vertebrate animals. The book contains much that is instructive and true and suggestive; but some of it is highly imaginative and must not be taken too seriously by the uninformed.

There is not much that is new in Mr. Alston's pleasant little volume (2). It is a collection of essays on a variety of topics ranging from the former existence of the wolf and beaver in Scotland to the value of different colours in the making of anglers' flies. The author is a keen field naturalist, and his ardent advocacy of the protection of indigenous British species of birds and mammals finds expression in the chapters devoted to the sea-eagle, the wild-cat and members of the weasel tribe. The book concludes with two chapters quite unsuggested by the title. One is upon elephants in Ceylon and the other upon the sheep-killing Kea parrot of New Zealand. In this there is a never previously published account of this bird, supplied to Mr. Alston by Mr. Alexander F. Brown, one of the survivors of the enterprising pioneers of the higher ranges of the South Island.

"The Sheep and Its Cousins" (3) is the outcome of work Mr. Lydekker has been doing for some years in carrying out Sir Ray Lankester's wise scheme for preserving permanent records of breeds of domesticated animals by exhibiting mounted specimens in a special gallery in the Natural History Museum. Mr. Lydekker has made good use of the opportunities afforded by his official position in that institution to get together examples of many rare forms of sheep, about which most zoologists had previously nothing beyond bibliographical knowledge. An account of these, together with descriptions of the principal European breeds and summaries of the highly speculative views of authors touching their origins and affinities, about which practically nothing is known, forms the greater part of this volume, which will form a useful guide for a more thorough and scientific treatise on the subject.

In connection with the oft discussed, but quite unsettled, question of the origin of tame sheep, one cannot suppress a feeling of envy at the assurance with which their differences from wild species are lightly dismissed as due to domestication; and one wonders if Mr. Lydekker realises that his adoption, or seeming adoption, of the view that they are descended from two or more distinct species involves the conclusion that their common characters must have been independently developed at least twice. It may be so; but the evidence for this amounts at present to very little. About the treatment of the wild species, one is at a loss what to say, except that if the author really knows them, apart from their geographical distribution, he has been very unjust to himself. Presumably, the scientifically indefensible inclusion of the Audad (Ammotragus) and the Bharal (Pseudois) in a volume devoted to sheep (Ovis), from which goats (Capra) are excluded, is a concession to popular terminology; but since Mr. Lydekker calls them "aberrant sheep" one suspects that he scarcely appreciates rightly the distinguishing characters of these four genera. Naturally, the book is not free from mistakes. For instance, it is stated that the female Bharal lacks at all ages the dark markings of the male. Probably this is never true. Certainly it is not always true. This and other errors, however, will no doubt be corrected in future editions.

(4) In compiling a catalogue of the skeletal and anatomical remains of the Cetacea, Sirenia, and Pinnipedia belonging to the University of Edinburgh, Sir William Turner has taken the opportunity of putting into the hands of zoologists an invaluable monograph containing brief definitions of the families, genera, and often of the species of these three orders, as well as descriptions of the chief osteological, dental, anatomical, and fœtal preparations in the rich collection at his disposal. A surprising amount of information is packed into the two hundred odd pages of the volume, and when one adds that it is illustrated with seventeen plates and more than one hundred text figures, no further evidence need be adduced of its usefulness to students of these orders.

For the classification of the Cetacea, the author has paid special attention to the characters displayed by the fronto-naso-premaxillary region, the rostrum, the hard palate and pterygoids, the teeth and the tympano-periotic bones, and, in the introduction to this order, the principal modifications of these parts of the skull in different genera are briefly detailed. The rest of this introduction contains an account, equally interesting to naturalists and zoologists, of species of whales stranded on the coast of Scotland both in recent times and in the prehistoric period before the land and sea had assumed their present level.

The aim of Dr. Lloyd's [illegible] (5) is, as he tells us, to lessen the belief in [illegible]atural selection as a creative agency, and its [illegible]es are devoted mainly to pointing out the [illegible]ons in colour and other characters presente[illegible] the common black rat (*Mus rattus*) in [illegible]. Exceptional opportunities for this valuable [illegible]e of statistical research work were afforded [illegible] the campaign against these pests undertak[illegible] the Plague Commission in 1907, exa[illegible] the material sent to Calcutta being [illegible] Lloyd's work.

He shows amongst other things that variation in the colour of certain areas, especially of the ventral surface and of the tail, is discontinuous and that not infrequently several individuals differ from the ordinary run of rats in a particular district by a combination of characters similar to those used by systematists for discriminating species or subspecies of Muridæ. In the case of *Mus rattus* it is tolerably evident that these individuals are members of a family party; yet, as Dr. Lloyd insists, if a similar series of individuals were to emanate from a "field" species of Mus and were to fall into the hands of a systematist, they would probably be regarded as representatives of an undescribed form and be named accordingly; and in that case they might for ever remain the sole examples of the species or subspecies, so-called. On the other hand, such a series might by isolation in their locality give rise to a persistent ype. Dr. Lloyd discusses the question of the rigin of "species" from mutants, and expresses e opinion that species have arisen in that way, respective of natural selection; and it seems that e would lessen, to that extent at all events, the lief in natural selection as a creative—one would ve preferred "guiding" or "fostering"— gency. He also supports his case by citing ower's records and statistics touching the tato beetle. His views are clearly and modestly t forward, and his book is worth careful atten- n, although the omission of an index, of a le of contents, and even of headlines to the apters makes the reading more difficult than need have been.

R. I. P.

METALLURGICAL INDUSTRIES.

A Text-book of Rand Metallurgical Practice. Designed as a "Working Tool" and Practical Guide for Metallurgists upon the Witwaters-and and other Similar Fields. By Ralph Stokes, Jas. E. Thomas, G. O. Smart, W. R. Dowling, I. A. White, E. H. Johnson, W. A. Caldecott, A. McA. Johnston, and C. O. Schmitt. Vol. ii. Pp. xxii+438. (London: C. Griffin and Co., Ltd., 1912.) Price 21*s.* net.

The Technolo of Iron Enamelling and Tinning. Being of lected Papers. By J. Grünwald. Translate rom the German by Dr. H. H. Hodgson. aueiii+139. (London: C. Griffin and Co., one 912.) Price 6*s.* net.

Notes on Foun ice. By J. J. Morgan. Pp. ix+108. (he positio C. Griffin and Co., Ltd., 1912.) Pritten holdsnet.

THE secons are inof this work is by Mr. C. Otebrates; thnd consists of two tions—"The Dre Acraniates Construction of luction Plant" characters a Transport of Material"—the latter naturally being the smaller, occupying the last hundred pages of the book.

The first section deals in a systematic manner with the reduction plant used on the Rand, taking in order the breaking plant, stamp mill, tube mill, sand plant, slime plant, and precipitation plant, and the author has covered this ground very thoroughly, giving much useful information; for instance, when considering the design of a reduction plant, the value of a volume diagram and a flow sheet, in addition to the plan and elevation of the plant, is pointed out. The chapter on "Sorting and Breaking Plant" is good, the subject being fully discussed, while under "Crushing Plant" there is a comprehensive description of the stamp mill found on the Rand, all various parts of the battery being considered.

The section on the modern foundations for mortar boxes is particularly instructive and is well illustrated. The "Nissen" stamp mill, which has recently been run experimentally at the City Deep, is briefly described. A most adequate account of the Rand cyanide plant is given, and it should be of use to all engaged in the cyaniding of gold ores, for the cyanide process has proved a most satisfactory means for the further treatment of the Rand ore, with the result that there have been great developments in the plant. An important chapter on "Estimating" is included, and the author of this volume rightly insists that a detailed estimate of the cost of a plant which has been designed is essential, and for this purpose gives a set of useful schedules.

In the second section of the book the plant for the transport of material is fully described, the methods of handling ore, dry sand, dry slime, pulp and sand residue being given. This section should be of general interest to mining and metallurgical engineers, for the lack of labour on the Rand has made mechanical handling of material a necessity; consequently a large number of appliances is considered.

The volume is copiously illustrated, and contains many useful tables and valuable diagrams as well as a good bibliography.

The work is, as the authors claim, a "practical book for practical men," and, although dealing with the metallurgical practice upon the Witwatersrand, will be of value to those engaged on goldfields where some of the conditions are similar. The advanced student who is studying the metallurgy of gold will find it a useful book, for it will broaden his outlook, give him an insight into industrial problems, and will put before him information gained by practical experience. The book can be thoroughly recommended.

(2) These papers form valuable contributions to the technology of iron enamelling, for particular problems or aspects of the industry are considered; but, so far as the technology of tinning is concerned, there are only three papers: one historical, another on the grey allotropic modification of tin, and the third giving short accounts of processes for the recovery of tin from tinned waste.

The papers which deal with the composition of various enamels and their mode of manufacture are the most important, and much information, gained by actual experience, is given. As very few works in the enamelling industry employ chemists, a paper showing how the chemical composition of an enamel may be determined by calculation has very wisely been included in the series. The paper with the title "The Examination of Cast-iron Enamels" has not been happily named. The translator is to be commended on the satisfactory manner in which he has carried out his work. Managers of enamel works and all those concerned with the problems of the enamelling industry will find much valuable information in these papers.

(3) This work deals chiefly with iron-founding, and gives a general description of the materials used, the methods adopted, and the appliances employed. The influences of the various elements usually present in cast-iron are discussed, and several analyses of pig-iron are given. The cupola and other foundry furnaces are briefly but clearly described, and an exceedingly good and concise description is given of moulding-sands and moulding. It would have been an advantage to have placed the sections on moulding-sand and openers later in the book, so as they would precede "Moulding." The book should prove very useful to technical students and to engineers who wish to gain a general idea of foundry practice.

OUR BOOKSHELF.

Die sanitarisch-pathologische Bedeutung der Insekten und verwandten Gliedertiere, namentlich als Krankheits-Erreger und Krankheits-Ueberträger. By Prof. Emil A. Göldi. Pp. 155. (Berlin: R. Friedländer und Sohn, 1913.) Price 9 marks.

HERE we have a clear and compendious account of the Arthropods concerned in the causation of disease, particularly of tropical diseases. It will, perhaps, be more useful in the class-room than in the laboratory, since, though the author is very sound in his appreciation of the entomological factor in pathological research, he treats his Arthropods by a sort of criminatory standard peculiarly profitable to the novice.

In the first section the Arthropods that bite and sting in their several ways are dealt with, the structure of the organ of offence and the nature and effects of the injury being described in every case. Here is included a multitude of figures of urticating caterpillars from South America. It will surprise those who know only the scorpions of the Old World to learn from the author that from 200 to 250 children are killed annually in Mexico alone by scorpions.

A second section is concerned with Arthropods as parasites of man. These are differentiated as occasional bloodsuckers, so far as man is concerned, such as mosquitoes, gadflies, &c.; professional bloodsuckers, such as Stomoxeinæ, bed-bugs, &c.; and thoroughgoing parasites, such as lice, fleas, bots, ticks, &c. The means and methods of offence and the effects of the parasitism are discussed; and the various kinds of parasites are described and figured, so as to make clear not only their general appearance, life-history, and metamorphoses, but also many necessary and contingent anatomical details.

The third section treats of Arthropods as carriers of specific pathogenic micro-organisms. Here the text is plentifully illustrated with figures of notorious micro-parasites in their various phases, of the infected tissues and organs of the specific Arthropod carrier, and of the disastrous effects upon the ultimate victims—men and domestic animals.

The book is written in a crisp and (if the adjective may be allowed in this connection) attractive style, and is well printed.

Grundzüge der allgemeinen Phytopathologie. By Dr. H. Klebahn. Pp. 147. (Berlin: Gebrüder Borntraeger, 1912.) Price 4.80 marks.

PROF. KLEBAHN's high reputation as a research worker in mycology leads one to expect in a book from his pen exactly what one finds in this volume: an admirable combination of clearness and terseness, the essentials of the subject being presented in a striking manner and the details of minor importance lightly touched upon or omitted. It is safe to assert that never has such an accurate, interesting, and philosophical account of the various diseases which afflict cultivated plants been compressed into fewer than 150 pages, and that this is probably the best general introduction to the study of phytopathology that has yet been published.

The book is characterised by its scientific rather than technical treatment of the subject, the author laying stress upon the necessity for a thorough understanding of the symptoms and causes of plant disease as a preliminary to the application of therapeutic and prophylactic measures, and he has deliberately limited his scope to pure pathology. Before proceeding to consider the diseases induced by fungi, insects, and other organisms, he discusses chemical and physical conditions of the soil, climatic conditions, wounds, smoke, and chemical fumes as causes of disease in plants;

and the wide view which is taken of the subject is further reflected in the sections at the end of the book devoted to non-parasitic diseases (caused doubtless by disturbances in physiological balance generally and in enzyme secretion particularly) and to various abnormalities in growth.

F. C.

The Bradshaw Lecture on the Biology of Tumours. By C. Mansell Moullin. Pp. 39. (London: H. K. Lewis, 1913.) Price 2s. net.

MR. MANSELL MOULLIN has published as a booklet the Bradshaw lecture which he recently delivered before the Royal College of Surgeons. It treats of new growths or tumours from the biological point of view; he regards the division of them into malignant and innocent as a mere useful convention; there is no sharp line of demarcation between the two groups. He prefers a division into those which spring from germ-cells and possess a more or less complete individuality, and those which spring from somatic cells and are due to escape from control of what remains to them of their primitive form of growth. The short course of an hour's lecture precluded any full treatment of this large subject. The various theories of malignancy are not discussed, but the parasitic nature of cancer is denied. With regard to cure, we have the confession that at present the surgeon's knife is the only safe remedy, though the lecture concludes with the hope that this will not always be so. No reference is made to the part chemistry has played or will play in the elucidation of the cancer problem. Until we know what are the biochemical or metabolic actions in the cells of a new growth, we can scarcely hope to grapple with the methods which will ensure recovery.

W. D. H.

The Physical and Political School Atlas. By J. G. Bartholomew. Pp. xvi of uncoloured maps and texts; 32 coloured maps. (London: Oxford University Press, 1913.) Price 1s. net.

THIS cheap and trustworthy atlas may be commended to the attention of teachers of geography. The attempt in some cases to show land relief and other physical features as well as the political geography of a country on one and the same map has led to overcrowding and indistinctness. Where this mistake has been avoided the maps are bold, clear, and convincing.

"Half-inch to Mile" Map of England and Wales. Sheet 3. Cumberland, &c. New and revised edition. (Edinburgh: John Bartholomew and Co., n.d.) Price, in case: 1s. 6d. paper; 2s. on cloth, or 2s. 6d. on cloth dissected.

LIKE other maps in this excellent series, this of the Lake District is reduced from the Ordnance Survey, and has been revised to date. The map is coloured in the now familiar browns and greens, and in consequence the surface relief can be understood with ease. All details likely to be required by tourists and sportsmen are indicated, and altogether this sheet well maintains the high reputation of the series.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Falling Birth-rate.

IN her lecture, delivered at University College, London, on February 25, Miss Elderton, of the Galton Laboratory, in dealing with the falling birth-rate, pointed out that the decrease is least acute in the mining districts; the engineering trades, which represent the best paid of the artisan class, come next; while textile districts coincide with residential districts in showing the biggest decrease; and she asks if there is some cause which operates to a special degree in certain classes.

One important operating cause, no doubt, is the large and increasing number of women employed in the textile trades. On the other hand, with the exception of a few pit-brow girls, practically no females are employed in the mining and engineering industries; and it is, therefore, perhaps scarcely surprising to find a greater birth-rate amongst the wives of miners and engineers than amongst the women in the cotton and woollen districts. The married woman operative in the Lancashire cotton mills, for example, knows that each new addition to the family entails some weeks' loss of work and wages before and after her confinement, and it also means an increased weekly charge when the baby is, according to Lancashire custom, "put out to nurse"; and no doubt this knowledge acts as a considerable check upon the birth-rate.

The decrease in the residential districts is due, no doubt, in part, to the "increase in luxury of living and love of pleasure" referred to by Miss Elderton, and in part also to the comparatively large number of women who are employed in such districts in domestic service. The rise in the average marriage age must also be taken into account.

Nor must we forget the influence of education. It is worthy of note that the fall in the birth-rate in this country practically dates from the passing of the Education Act in 1870. This new influence would make itself felt in a variety of ways. The check on the employment of child labour, for example, would tend to act as a check on the birth-rate, for whereas formerly children became wage-earners at a very tender age, they would, after the passing of the Act, not only cease to be wage-earners, but would actually be an increased charge on the parents. The increase in the knowledge of physiology, which has spread in recent years as a result of free education, may also not be without its influence.

Yet another factor—again ascribable not very indirectly to free education—is the change in religious sentiment which has been so pronounced during the last quarter of a century. Among other things, people are beginning to doubt whether, in these days, the "quiver full" of children is the unqualified blessing which the Psalmist declared it to be. They are realising that it is better to be the parent of two or three children, well provided for, than of a half-score or so of starvelings.

Miss Elderton also tells us that "a further analysis of figures for several northern towns shows generally that the higher the wages the smaller the family." This is exactly what, other things being equal, one

would expect. If we look to the animal world we shall, broadly speaking, find that as we rise from the lowliest to the highest organisms, there is a steady decrease in the number of offspring, while at the same time there is a lengthening of the period during which the offspring remain under the care of the parents. In the case of the human race we find that increasing civilisation brings with it a decreasing birth-rate, and a lengthening period of "schooling" for the children; and it is amongst the least intelligent (which is also usually the lowest paid) section of the community that the birth-rate is the highest. A glance at the birth-rate of our English towns will show that in those districts where there is greatest poverty and congestion, there tends to be also a comparatively large birth-rate.

The foregoing views would seem to be borne out by the fact which Miss Elderton mentions, that Liverpool, "which is not a cotton town, and where the amount of irregular and casual labour is singularly large, is one of the two cases in Lancashire where the birth-rate shows a rising tendency," and also by her statement that "from Bradford figures have been obtained showing how in homes where the mother's health or habits are bad, or where the ventilation is bad, there is on an average about one child more than in homes where these features are good."

To quote the words of Dr. Saleeby, "a chief factor of progress has been the supersession of the quantitative by the qualitative criterion of survival-value. The principle of the fall of the birth-rate is one of the great consistent facts of organic history, and may be traced from the bacteria upwards, through such representative invertebrates as the insects, even through fishes, the first vertebrates, up to man, and amongst the various nations and strata of human society. The tendency of progress, in short—a tendency coincident with the evolution of ever higher and higher species—is to pass from the horrible Gargantuan wastefulness of the older methods towards the evident but yet lamentably unrealised ideal—that every child born shall reach maturity. . . . All organic history proves that a low birth-rate is a mark of high vital level."

J. ANDERSON.

17 Laburnum Road, Gorton, Manchester,
March 5.

THE above letter contains no addition of any ascertained *fact* to those cited by Miss Elderton. Miss Elderton, in her lecture, brought forward a very large amount of evidence to show that the *net* family of the socially less valuable members of the working-classes was larger than that of the socially more valuable members of the same classes. That within a given species the individuals of inferior physique and mentality have relatively greater fertility must mean the degeneration of that species; and no scientific argument can be opposed to this based upon the illogically extended syllogism: "higher" species have lower birth-rates; there is a lower birth-rate in the more valuable members of the artisan classes; hence this tends to convert those classes and their nation into "higher" types of life.

If we start to reason from analogy of this kind, we might argue that the elephant would in the end supplant man, or that the mastodon—for aught we can say to the contrary—ought to have survived all his contemporaries. It is the old fallacy of the Neo-Malthusians, who have never made any real attempt to grasp the race suicide involved in the survival of the unfit by reproductive selection—*i.e.* by their greater fertility, when it is unchecked by natural selection. Argument from analogy, when data are available, is always idle; argument from what is known of species to what must hold of individuals is still more fallacious.

Lastly, association is not causation; a "higher" individual may have fewer children, but this does not demonstrate that his height (however that vague word be defined) is produced by his lesser fertility, or that a race with a large section of its "higher" individuals practically sterile will survive in the battle of nations. History shows many cases of the decline of nations whose intellectually abler members were sterile. I can recall no case of a race with a very low birth-rate maintaining or creating a position for itself in the assembly of nations.

I have not trespassed on your space by commenting on Mr. Anderson's other statements. He was clearly not present at Miss Elderton's lecture, or he would have been aware that her data were all based on *married* women, and had due reference to their *ages*. While the actual birth-rate of wives, fifteen to forty-five years of age, has fallen 30 per cent. to 50 per cent., the *potential* birth-rate of the same wives has fallen a few points, or in many districts not at all.

KARL PEARSON.

Galton Laboratory for National Eugenics,
University of London, March 11.

The Radio-Elements and the Periodic Law.

IN his letter in NATURE of March 20 Mr. Soddy states that "granting the possibility of the existence of groups of elements with identical chemical properties and spectra, the only known direct manner in which the existence of the members of these groups could be separately recognised is radio-active evidence." I should like to suggest that another possible method of distinguishing such elements is provided by their characteristic X-radiation. According to Rutherford, the γ-radiation emitted by a radio-active element is identical with its characteristic X-radiation; is the γ-radiation of thorium D identical with the characteristic X-radiation of thallium, or the γ-radiation of radium D with the characteristic X-radiation of lead? From such experimental results as I can discover after a brief search, it would appear that the answer to this question is in the negative.

It seems probable that a difference might exist between the characteristic X-radiations of elements chemically identical, for the properties of that radiation, like the radio-active properties, are probably determined by the fixed electrons, forming part of the permanent structure of the atom, since both sets of properties are independent of chemical combination; on the other hand, the chemical properties are probably determined by the valency electrons which are readily detached from the atom. If chemically identical elements have the same spectra, it would appear that the spectra are also determined by the valency electrons, a conclusion contrary to that involved in Stark's theory of the origin of spectra.

NORMAN R. CAMPBELL.

Leeds, March 23.

The Occurrence of the Archiannelid, Protodrilus, on the South Coast of England.

THE discovery of the presence of the Archiannelid, Protodrilus, on the English coast is an interesting fact inasmuch as it extends the known domain of a genus of an archaic group of animals, and also adds a valuable animal to our records. So far as is known

Protodrilus appears to inhabit only the European seas, having been taken in the Black Sea, the Mediterranean, at Heligoland in the North Sea, and at Ambleteuse, on the French side of the Straits of Dover. Protodrilus was found on March 2 in a small bay just outside and to the east of Plymouth Sound. On March 11 the spot was again visited, and a large number of specimens, more than a hundred, gathered in about an hour. The animals were found almost at the high-water mark among stones and gravel at a point where a small stream of fresh water runs into the sea.

It is an interesting fact that the animals are immersed at one period in practically fresh water, and at another period in sea water; samples of the water in which the animals were living taken at low water during the neap and spring tides were found to have densities as indicated by a hydrometer of about 1·001 and 1·009 respectively; while the density of a sample of sea water taken just outside the breakwater at Plymouth, estimated by the same instrument, was found to be about 1·025.[2]

These specimens of Protodrilus are undoubtedly different from those previously taken at Ambleteuse and Heligoland, but they resemble in some characters both the Mediterranean forms, *Protodrilus flavocapitatus*, Uljanin, and *Protodrilus spongioides*, Pierantoni. The former of these species occurs in situations which are never covered by more than a few decimetres of water, while the latter is represented by only four specimens taken from fresh water. A fuller investigation of the English specimens is being undertaken in order to compare them in more detail with the known species of this genus.

The English Protodrilus were living in the situation described above along with *Gammarus marinus*, an Oligochæte and *Gunda* (*Procerodes*) *ulvae*; the latter of these species was first taken in this spot in great numbers two years ago, and does not appear to have been recorded previously on the English coast.

J. H. ORTON.

The Laboratory, Citadel Hill, Plymouth.

[1] U. Pierantoni; "Fauna und Flora des Golfes von Neapel." Vol. xxxi. Protodrilus. 1908.

[2] These values of density were made at temperatures between 15° and 17° C., and are to be regarded as approximations only to the absolute density; as the water in which the Protodrilus were living would be constantly changing, it was not considered worth while to analyse accurately two random samples.

On the Gain of Definition obtained by Moving a Telescope.

THE following is an account of a very singular fact which came recently under my notice, and for the explanation of which I am absolutely at a loss.

I am in the habit of rating my chronometer by means of the time-ball dropped at the Greenwich Royal Observatory, about 3½ miles away, a signal which I observe in a small hand telescope.

On March 11, the weather being misty, I failed to pick the signal post, although I knew exactly where it was, and had placed the telescope exactly in the right direction. I moved the telescope a little, thinking I had displaced it in putting my eye to the eyepiece, and I immediately saw, very dimly, the dome of the observatory, and the signal, with the ball at half-mast, and noticed that *they were in the centre of the field all the time.* As soon as I steadied the telescope, however, they vanished completely. They reappeared as soon as I began to "sweep" for them, but remained discernible only while the motion lasted. I repeated the experiment several times; the signal was really invisible while the telescope was fixed, but by imparting to it a slow oscillation right and left I kept the signal in view with sufficient distinctness to see the ball drop, although I was not certain it had really dropped until a second or so afterwards, owing to the great faintness of the image observed.

I recollected then that, often, in similar conditions of seeing, having picked the signal without any difficulty *while "sweeping" for it.* I had failed to see it afterwards, and gave up the attempt, thinking I had been mistaken, or that the mist had become thicker. I have therefore no doubt as to this most curious and inexplicable fact: an indistinct object is better seen in a slowly moving telescope than in the same telescope when kept steady. There must be a very interesting physiological property of the eye involved in producing this result, which is quite in opposition with what one would naturally expect. Perhaps some of your readers have noticed something similar, and could throw a little light on this mysterious phenomenon.

M. E. J. GHEURY.

Woolwich Polytechnic, March 15.

Four-horned Sheep.

MR. RITCHIE'S note on four-horned sheep in NATURE of March 6 is interesting, but I am inclined to doubt whether there ever was, in Scotland or any other country, a breed in which four horns are normal. No doubt it is possible to fix this character in the male sex by careful selection, as has been done by some breeders of the spotted or Barbary sheep (sometimes called Spanish, Syrian, or Zulu sheep); but even these have not succeeded in fixing the character in the female sex. I have evidence, in the shape of specimens or photographs, of the existence of four-horned sheep in North and South Africa, Mongolia, China, the Himalayas, Baluchistan, and Chile. The Iceland breed was supposed to be four-horned, and no doubt four-horned examples were often found amongst them, a specimen I have being precisely similar in type to an abnormally four-horned Shetland.

My own experience of four-horned rams is that in most cases the lower horns, and in some cases the upper also, require to be cut at some time in their life to prevent them from growing into the cheek, or below the jaw, so that the animal cannot graze; and this no doubt would have a tendency to eliminate the four-horned rams where not specially selected. No instance is on record, so far as I know, of any wild sheep having more than two horns, neither have I seen any skull of domestic sheep in which there were more than four horn-cores, though five-, six-, and even eight-horned sheep have been recorded.

H. J. ELWES.

Colesborne Park, near Cheltenham, March 14.

THE EXPERIMENTAL STUDY OF FLUID MOTION.[1]

MANY attempts have been made to study the motion of fluids past an obstacle by experimental methods, and experiments made for this purpose may be divided roughly into two classes:

(*a*) Those in which the fluid is made to flow

[1] The figures which accompany this article are from the Technical Report of the Advisory Committee for Aëronautics for the year 1911–12, and are reproduced with the permission of the Controller of H.M. Stationery Office.

FIG. 1.—Low velocity type of flow. Air.

through a channel past a model which is fixed in the channel.

(*b*) Those in which the fluid is at rest in the channel, the model being moved relatively to the fluid and channel.

In both methods great difficulties are met with if the velocity of flow be high, owing to the rapid movements of the fluid, but in the first method the fact that in a channel the flow becomes turbulent when the critical velocity is reached

FIG. 3.—Low velocity type of flow. Water.

FIG. 2.—High velocity type of flow. Air.

makes observation at high velocities almost impossible.

During the past two years a research on fluid motion has been in progress at the National Physical Laboratory, and a brief description of some of the experiments which have been described in the report of the Advisory Committee for Aëronautics may be of interest.

The Teddington experiments have all been made in the "flowing fluid" type of channel, the flow in both air and water being studied at velocities below the critical velocities of the channels used.

A number of methods for indicating the direction of motion of the fluids have been tried, and, up to the present time, the best results have been obtained:

1. *In air*, by allowing tobacco smoke to issue from a jet at the velocity of the surrounding air stream, on the upstream side of the model under investigation.

2. *In water:*

(*a*) By coating the model with condensed milk, which is washed off into the eddying regions, making visible the movements of the fluid in those regions.

(*b*) By introducing minute particles of oil (aniline and toluene) of the same density as the surrounding water, the direction of motion of these particles being recorded photo-

FIG. 4.—High velocity type of flow. Water.

graphically. It should be noted that these photographs, which are short-time exposures, indicate not only the direction of motion in any region, but also the velocity of motion, which is obtained from measurement of the length of the lines, comparison being made with the length of the lines in the open channel where the velocity is known.

Some examples of the results obtained are shown in the accompanying photographs, which are taken from the report of the Advisory Committee for Aeronautics, 1911–12.

FIG. 7.—De Havilland strut.

FIG. 5.—Flat plate.

Figs. 1 and 2 show the flow past an inclined square plate in air at two different velocities (by method 1). Figs. 3 and 4 show the same types of flow in water (by method 2 [a]). Figs. 5 and 6 show the flow past a plate in water (by methods 2 [a] and [b]). Fig 7 shows the flow past a strut in water (by method 2 [b]). Fig. 8 shows the dead region which exists, even at low velocities, at the tail of an airship model.

FIG. 8.—Dead region at the tail of an airship model.

The last figure is of some interest, as it has been found that where a dead region exists at the tail of a fish-form model, the resistance of the model is not appreciably affected by the shape of the tail within this region, and so long as the tail is sufficiently blunt to cause the formation of "dead air" (as is usually the case in airships, aëroplane hulls, struts, etc.) it is convenient for constructional reasons to end the tail rather abruptly once the boundary of the dead region has been passed.

FIG. 6.—Flat plate.

A dead region is always an indication of high resistance, and is therefore undesirable.

It is hoped that observation of the flow past models, together with resistance measurements,

will in the near future supply the data necessary to enable the designer of aircraft to construct fish-form bodies of low resistance and high efficiency.

C. G. E.

LIVINGSTONE AS A MAN OF SCIENCE.

NOW, as in the year 1874, which followed his death, discussions are being carried on as to whether Livingstone was more a missionary of religion than a man of science or an enthusiastic and skilful geographer. Such contentions are a waste of argument. Livingstone ardently believed in the supreme value of Christian ethics and the power of undenominational, basic Christianity to raise the backward peoples to a happier condition of life; but to his broad mind—a mind fifty years in advance of most of its contemporaries—reasonable religion and honest science were the same thing. Most of the dogmas of his day—for which people were still being persecuted—he tacitly ignored as being either unprovable or so little essential to "true religion and undefiled" as not to be worth discussion.

If Livingstone had lived seventy years later, he would probably have sought for some science scholarship or endowment and have gone out in his religious search for knowledge as a layman, a layman of that most holy profession, the healer of disease. He had about him the making of another Darwin. As it was, he chose the path of the missionary, and fortunately selected that missionary society (the London) which had already produced men like Campbell and Moffat, and which left with its agents singular freedom of movement and judgment. Consequently, he was able to enrich science with much material for the comprehension of Africa, even when working as a missionary at a modest salary of 100*l.* a year.

No one has ever charged Livingstone with neglecting to do the work of this profession. He taught, he expounded, he translated, pleaded; and exercised a most potent influence for good over the minds of thousands of savages; impressing their chiefs, moreover, so strongly with the worth of his character and the exemplar of his own hard-working, blameless life, that he really laid firm foundations for the Christian civilisation which has now laid hold on Bechuanaland. But from the moment of landing in South Africa he stored up all the observations he could put into writing on the African flora, fauna, geology and native races.

A review of his work as a practical philanthropist, a consul and a geographer has been already dealt with by various writers during the month which preceded the centenary celebrations. Perhaps the best and the most novel treatment of these aspects of Livingstone is that given in three articles by Mr. Ralph Durand in *The African Mail.* *The British Medical Journal* has published an essay on the medical and surgical skill of Livingstone and his great ability in this profession, besides his anticipation of the modern treatment of malarial fever and the cogency of his researches into tsetse-fly disease. To get an all-round view of the capacity of this remarkable man there only remains to be considered his quality in other branches of scientific research—philology, ethnology, zoology, botany, geology and meteorology.

In about a year after arriving in South Africa he had mastered the Sechuana language and had acquired a vehicle for conversation with the tribes between the Orange River and the Upper Zambezi, the Limpopo and Lake Ngami; for many of the Bushmen could speak some Sechuana dialect, and the conquests of the Makalolo (a Basuto tribe) had carried the Sechuana tongue northwards almost to the verge of the Congo basin. But Livingstone, appreciating the great interest which the Bantu language-family possessed for philologists, busily collected vocabularies of the still little-known languages of Ngamiland and the western Zambezi; and though these are either stored at the Grey Library at Capetown or lost, they served the purposes of Dr. W. I. Bleek in assisting him to compose his unfinished "Comparative Grammar of the South African Languages." Ethnology owes a great debt to David Livingstone. It is impossible to write on the races of South Africa without quoting from his stores of information—information which is exact, unemotional, graphic and discerning. He wrote on the Stone Age in Central Africa before anyone had thought of such a period in negro culture; on the ancientness of pottery among the Bantu; on the domestic animals of south Central Africa; on fragments of unwritten history and half-forgotten migrations; on the importance of the Pleiades as a measurer of the seasons in the eyes of the African agricultural folk; on the racial and cultural influence of ancient Egypt on negroland.

His notes on the life-history and habits of the lion, ratel, giraffe, rhinoceros, buffalo, elephant, giant chimpanzi, baboon, hippopotamus, zebra, lechwe, situtunga, and the other striking mammals of southern and Central Africa, are strewn through his three published books, and have done good service in many a natural history book. No succeeding naturalist traveller has called his information in question. Amongst his discoveries in zoology were several antelopes and the pygmy elephant of the Congo forests, "a small variety, only 5ft. 8 in. high, yet with tusks 6 ft. 8 in. in length." (This form was only rediscovered by the Germans a few years ago.) Livingstone's notes on birds, lizards, snakes and frogs are as good reading and as accurate as those on mammals. His observations on the part played in the economy of nature by the termites (which consume and cover with soil all dead timber) were subsequently confirmed and elaborated by the late Prof. Henry Drummond.

Livingstone's botanical collections and innumerable botanical notes—more especially about the Zambezian flora—are incorporated in the old and the new editions of the "Flora of Tropical Africa." His discovery of fossil Araucarias in the rocks of the Central Zambezi valley led him to guess

at the ancient connection between South Africa, Australia and South America. His sketch of the geology of Central Africa, written in 1857, his description of the former plutonic activities of the south-west Tanganyika region, of the coal-bearing strata of the Ruvuma and west Nyasaland, and his hearsay reports of the gold and copper of Katanga have stood the test of time in their substantial accuracy. His meteorological records of the rainfall, temperature and climate of Central Africa still await publication.

Indeed, it is possible that much of Livingstone's scientific research work has never yet been published, and that when it is disinterred and printed we may find ourselves still further indebted to this missionary-consul-explorer for valuable information about the southern third of Africa.

H. H. JOHNSTON.

PLANT DISEASES AND INSECT PESTS.

MOST of the investigations on this subject are carried out at agricultural research institutions and have for their primary object the discovery of means for destroying the pest, rather than the elucidation of the relationship between the host and the parasite. Yet the latter problem must be of extraordinary interest, and we can only hope that the investigators will turn to it as soon as some of their pressing economic problems are solved.

Of the British Colonial departments, the West Indian is among the most prolific in publications on these subjects. The papers are issued in the reports of the various schools and departments and in *The West Indian Bulletin*. No. 4, vol. xii., of this journal contains papers by H. A. Ballou, J. R. Bovell, and F. W. South on the use of entomogenous fungi in combating scale insects in Barbados, one of the most interesting methods of pitting one organism against another for the benefit of mankind. Fungi parasitic on the insects are cultivated and the spores distributed: they are then applied to the insects directly these appear on the tree. The authors are very hopeful about the method; one, indeed, thinks it may enable most of the insect pests to be kept in check.

The bud rot of the cocoa-nut palm, described by J. B. Rorer in another paper, is an interesting example of a bacterial disease of plants. The disease has been much studied in the United States by Johnston (Bull. 228, U.S. Dept. of Agriculture), who comes to the remarkable conclusion that it is caused by *Bacillus coli*.

The United States Department of Agriculture and the entomological laboratories of the various colleges are, however, by far the most active investigators of plant diseases and insect pests. From the department itself issues a continuous stream of publications which we cannot pretend adequately to review. A. L. Quaintance has recently, in Circular 154, described the leaf blister mite (*Eriophyes pyri*, Pagenstecher), one of the smallest animals (they are not true insects) attacking horticultural crops. H. M. Russell, in Circular 151, deals with the greenhouse thrips (*Heliothrips haemorrhoidalis*, Bouché), which does considerable damage in attacking ornamental plants. E. S. Tucker, in Circular 152, describes the rice water-weevil (*Lissorhoptrus simplex*, Say), the larvæ of which feed on the roots of rice plants, while the adult weevils cause some harm by feeding on the rice leaves; altogether, this insect is regarded as the most serious enemy of rice in the southern States.

The Hawaiian Station has issued an account of Dr. Lyons's investigation of the curious sugar-cane disease known as *iliau*, endemic in the island and not known elsewhere. He traces it to a fungus producing two types of fruiting bodies: a perfect form belonging to the genus Gnomonia and an imperfect form referable to the genus Melanconium; he proposes to call it *Gnomonia iliau*.

NOTES.

THE ninth International Congress of Zoology now sitting at Monaco, under the presidency of H.S.H. the Prince of Monaco, was opened on Tuesday at the Oceanographical Museum. There are seven sections and one subsection, as follows:—(1) Comparative Anatomy and Physiology; (2) Cytology and General Embryology; (3) Systematic Zoology; (4) General Zoology, Palæozoology, and Zoogeography; (5) Oceanographical Zoology and Plankton; (6) Applied Zoology, Parasitology, and Museums; (7) Zoological Nomenclature; subsection, Entomology. Every consideration for the convenience and comfort of members has been given. The sections meet in the Oceanographical Museum and Lyceum, close by. The common subject of conversation of members is concerning zoological nomenclature; we learn that there have been several preliminary unofficial meetings, and that proposals are forthcoming which will probably result in a decision satisfactory to zoologists in general. The Prince of Monaco opened the proceedings on Tuesday at 6 p.m., after which there was a reception in the museum. The programme shows that there are many and interesting communications. British membership on the opening day exceeds eighty out of a total of 723, the largest yet recorded for any international zoological congress. There is, however, not a proportionate number of British communications; those on the list on Monday were by Prof. Elliot Smith, of Manchester; Prof. J. Arthur Thomson, of Aberdeen; Dr. R. F. Scharff, of Dublin; Mr. E. Hall, of London; Dr. E. J. O. Hartert, of Tring; Dr. W. S. Bruce, of Edinburgh; Dr. M. Annandale and Dr. B. L. Chandhuri, of Calcutta; Dr. R. J. Anderson, of Galway; and Dr. Hornell, of Madras. Lord Walsingham will move an important resolution on zoological nomenclature, and among British members who are likely to take part in this discussion are Dr. S. F. Harmer and the Hon. Walter Rothschild.

EXCEPTIONALLY wild and stormy weather was experienced over the south of England on Saturday, March 22. A severe thunderstorm occurred in the

southern counties in the afternoon, and this was followed by a brisk freshening of the wind, which developed during the evening to a violent gale. At 6 p.m. the centre of the storm was over Cornwall, and by 7 a.m. on Sunday morning it had reached Berwick, the disturbance progressing at the rate of more than forty miles an hour. A velocity of sixty-three miles an hour was attained by the wind at Kew at 8.50 p.m., and at 10.35 p.m. the hourly velocity was sixty-five miles an hour. On the south coast of England, where the greatest force of the gale was experienced, the wind attained the velocity of seventy to seventy-five miles an hour. The storm is probably the worst experienced for about the last eight years. Shortly before midnight the wind and sea carried away about 200 yards of the pier at Worthing. Much damage was wrought at Bungalow Town, near Shoreham, and also at Hythe, in Kent.

A SEVERE and destructive tornado occurred in the United States on the evening of Sunday, March 23. The greatest damage was done at Omaha, Nebraska, where about 150 people are said to have been killed and many more injured. The tornado swept the central States, and damage is reported from many places. Blocks of buildings were wrecked, and trains are reported to have been torn from the rails. Fire occurred in the wake of the tornado, and the torrential rain which followed the storm helped materially in extinguishing numerous conflagrations. The path traversed by the tornado is said to have been between 200 and 350 yards wide. At Omaha the storm is reported to have demolished one hundred and fifty houses and eleven churches. A report from Indianapolis states that owing to heavy rains following the tornado, the rivers in the State have overflowed their banks, and it is feared that there will be the worst floods for years. Several towns are reported as submerged.

ON Tuesday next, April 1, Dr. A. Smith Woodward will begin a course of two lectures at the Royal Institution on recent discoveries of early man, and on Thursday, April 3, Dr. E. Frankland Armstrong will begin a course of two lectures on (1) the bridge into life, (2) colour in flowers. The Friday evening discourse on April 4 will be delivered by Dr. J. J. Dobbie on the spectroscope in organic chemistry, and on April 11 by Mr. C. J. P. Cave, on the winds in the free air.

THE second circular of the International Geological Congress, 1913, has recently been issued. A change in the date of the sessions is notified: the meetings of the congress will begin at Toronto on Thursday, August 7, instead of August 21, as previously announced, and will terminate on August 14. The principal subject selected for discussion is "The Coal Resources of the World," and following the excellent precedent of the Stockholm congress, a large monograph on this subject will be prepared. The response from all over the world has been so cordial that the committee hopes to have the two quarto volumes and folio atlas ready in time for the meetings. The price will be twenty dollars the set. Other topics to be discussed are:—(2) Differentiation in igneous magmas; (3) the influence of depth on the character of metalliferous deposits; (4) the origin and extent of the pre-Cambrian sedimentaries; (5) the subdivisions, correlation, and terminology of the pre-Cambrian; (6) to what extent was the Ice age broken by interglacial periods?; (7) the physical and faunal characteristics of the Palæozoic seas, with reference to the value of the recurrence of seas in establishing geological systems. Authors of papers are specially invited to bring specimens to illustrate them, for which ample space will be provided, and the Department of Customs will give facilities for their entry into Canada duty free. A magnificent series of excursions has been planned, which will give an insight into the general geology, and particularly the glacial, pre-Cambrian, and economic geology of Canada. Twelve of these will take place before the congress; ten short excursions will be held during the congress and nine after. The first excursion starts from Montreal on July 13, and the longest of the post-congress excursions will reach Vancouver on September 22. Particulars may be obtained from the secretary of the congress, Victoria Museum, Ottawa, or from any geological society or survey.

MUCH attention is now being paid to the archæological remains in Jersey. In Bulletin No. 3 for 1912 of the Société d'Anthropologie de Paris, Dr. Deyrolle and Capt. Mauger describe the excavation of the tumulus and dolmen known as Teste-du-fief, in the northern part of the island. The owner has wisely decided that, after being opened, the monument is to be, so far as possible, preserved for examination by visitors, in its original condition. Within the dolmen the remains of a man buried beside his horse were discovered. Close to the right hand of the corpse was a small clay vessel, and close by a collection of horse teeth. Further information regarding this important discovery will be awaited with interest.

WE have received a copy of the first number of *Der Fischerbote* (Hamburg) for 1913, which contains much interesting information with regard to German fisheries, both in Europe and East Africa.

A VERY interesting new generic type of side-necked (pleurodiran) tortoise from the Keuper, in the neighbourhood of Stuttgart, is described by Prof. O. Fraas in *Jahresheft Ver. vat. Naturk. Württ.*, 1913, No. 80, under the name of *Proterochersis robusta*. Its peculiarity consists in the presence of two complete pairs of mesoplastral elements in the lower shell, which is believed to be a unique feature in the order. As a mesoplastron seems to be a primitive feature, its duplication appears to represent a still more archaic type. In vol. lx. of the "Palæontographica" (pp. 275–294) the same writer describes several new large labyrinthodonts from the Swabian Trias, one of which is referred to Cyclotosaurus, based on Meyer's *Capitosaurus robustus*, the genus also including the so-called *Capitosaurus stantonensis*, of the Warwickshire Keuper.

The American Naturalist for February contains four addresses on organic and inorganic adaptation in nature, delivered at the Symposium on this subject, at

the meeting of the American Society of Naturalists at Cleveland on January 2, and a fifth on the fitness of the environment, being an inquiry into the biological significance of the properties. In the first Prof. Mayfield discusses adaptation through natural selection and orthogenesis, and in the second Prof. Livingston adaptation in the living and non-living, while in the third Prof. Parker considers adaptation in connection with animal reaction, and in the fourth Prof. Mathews reviews the subject from the point of view of the physiologist. As our readers may wonder what is meant by non-living adaptation, it may be mentioned that Prof. Livingston cites the case of pumice fragments in an inundation of the Colorado river. "Had it not been for the floating adaptation, these pumice-pebbles would have suffered temporary extinction in the form of submergence, and would not have been able . . to gain dominance . . . in certain . . . beaches.'

We have received a copy of the issue of February 7 of an apparently new journal, published by the California Associated Societies for the Conservation of Wild Life at San Francisco, under the title of *Western Wild Life Call*. California, it seems, is one of the States in which wild-killed game is still permitted to be sold, and it is one of the main objects of the new venture to obtain the total prohibition of this branch of trade. Among the species or races of animals in imminent danger of extermination in California, even if some of them have not been already killed off, are the wood-duck, the sharp-tailed duck, the prongbuck, two kinds of wapiti, the beaver, and the sea-elephant. The fate which has already overtaken the passenger-pigeon is now threatening the band-tailed pigeon (*Columba fasciata*) in California, a species which has somewhat similar habits, and is now being slaughtered in enormous numbers. So urgent is the case that total prohibition for a period of at least five years, and subsequently an annual close season, are deemed necessary.

Apropos of the correspondence which we have recently had on "retinal shadows," Mr. J. L. Herrick writes suggesting an explanation of the twinkling of distant lights. He has noticed at his home in Yonkers, New York, where there are many street lamps at different distances, that only the more distant lights twinkle, and he thinks that the occultation of the lights may be due to blood corpuscles in the retinal vessels. He applies the same explanation to the twinkling of stars. The latter phenomenon has received many explanations, physical and physiological. With regard to the latter, the subject was brought to the notice of the Physiological Society some years ago by Dr. J. S. Haldane, and was discussed by the members. Several suggestions were advanced, amongst others that it was due to the pulse waves in the retinal vessels. No adequate proof of any of the physiological theories was brought forward, and it is doubtful whether any theory yet adduced amounts to more than a plausible hypothesis.

A report of the experiments carried out for the Durham County Council, on the feeding of dairy cows, has been published in bulletin form (Offerton Bulletin No. 4), by Mr. F. F. Walker. The experiments include a comparison of soya cake with decorticated cotton cake, and Sudan dura with maize. In the former case soya cake gave, if anything, slightly better results than cotton cake, and in the latter dura was shown to be equal in value as a food to maize, and might profitably be adopted as a substitute in times of low prevailing prices. Other experiments with "crowdy" or watery foods as against concentrated foods tend to show that, on the whole, the quantity and quality of the milk are not affected. A possible action of "crowdy" rations in maintaining of the flow of milk for a longer period than dry rations is indicated.

Dr. E. J. Russell and Mr. F. R. Petherbridge contribute a paper to the January number of the Journal of the Board of Agriculture on the sterilisation of the soil for glasshouse work. In continuation of earlier experiments on this interesting and complex problem, the authors have investigated the influence of heat and numerous antiseptics on the fertility of tomato-, cucumber-, and vine-sick soils, and have accumulated sufficient evidence to show that one or other of the various modes of treatment might be distinctly useful to practical growers. The effects of treatment may be attributed, in general, to the following changes:—(1) An increased bacterial activity with greater food production; (2) the reduction in numbers or death of disease organisms; (3) a modification of processes going on in the soil, so that certain unusual substances are present which produce special effects on the plant. These lead to early maturity and greater yields of tomatoes, early maturity in the case of cucumbers, and darker green and larger foliage and larger and brighter flowers with chrysanthemums. The best results were obtained in heated soils or those treated with formaldehyde, pyridine, or the higher bases, collidine, lutidine, &c.

Mr. R. Kirkpatrick, after zealous travel, considerable reading of recent geological literature, and painstaking observation, publishes a pamphlet entitled "The Nummulosphere" (Lamley and Co., London, 1913). In this he attempts to resuscitate Eozöon by finding structures of a discoidal nature common to it, to nummulites, and to almost every rock that he examines. The existence of these discs in nummulites is held to prove that all these other materials, including igneous lavas and granites, are of organic origin.

Students of the British Trias will find two papers of interest in the Proceedings of the Liverpool Geological Society, vol. xi., part iii. (1912). Rev. C. E. Spicer (p. 201) writes from personal observations of "Present Trias Conditions in Australia," and Sir T. H. Holland (p. 227) describes "The Origin of Desert Salt Deposits," laying special stress on the carrying of salt as fine dust by prevalent winds across the plains of north-west India. The "red marls" of the Trias are regarded (p. 245) as oxidised representatives of the black muds stained by ferrous sulphide found in modern salt-lakes in desert lands. Reasons are given (p. 246) for regarding the wind-borne salt

as insufficient to affect Prof. J. Joly's use of the sodium in rivers and in the ocean as a measure of geological time.

FROM an educational point of view, no work issued by the United States Geological Survey has been more important than Professional Paper 71, by Mr. Bailey Willis, entitled "An Index to the Stratigraphy of North America" (1912). This memoir of 894 pages is accompanied by a coloured geological map of North America on the scale of 1 : 5,000,000, which includes, t only Mexico, the United States, and Canada, but ntral America, the West Indies, Greenland, and eland as accessories. We should recommend the mounting of this map on large folding sheets, after the excellent manner of the Oxford wall maps, so that the whole or any of the four sections can be hung up as required. The paper is much more than an "index," since the formations are described in detail, and the views of various authors as to their modes of deposition are freely quoted. Canada is thus represented by her own authorities. The most striking features on the map are the immense areas covered by Tertiary volcanic rocks in the western Cordillera, and, in contrast, the severe pre-Cambrian region of the north-east, beyond the folded Mesozoic strata of the Rocky Mountains.

IN common with all other great earthquakes, the Messina earthquake of December 28, 1908, was followed by a large number of after-shocks. A record of the shocks felt at Messina was kept by Mr. G. Spadaro, then a student in the Nautical Institute in that city. During the last four days of 1908, eighty-seven shocks were felt, and during the following year 862. The majority of these shocks were, as usual, very slight, but four (in December, 1908, and January, 1909), were ruinous, and one (in July, 1909) almost disastrous. Dr. Agamennone points out (in the *Rivista di Astronomia*, &c., for last November) that the distribution of these shocks in time does not follow the simple law which, according to Prof. Omori, governs the decline in frequency of Japanese after-shocks, namely $y=k/(x+h)$, where y is the number of shocks in a given interval at time x, and h and k re constants, for the monthly number is greatest in March, 1909, and shows an increase in frequency owards the end of that year.

IN the *Revue générale des Sciences* for February 28 Prof. H. Devaux, of the University of Bordeaux, gives *résumé* of his researches on the properties of thin ayers of oil spread on the surfaces of water and mercury, a subject on which he has published a number f papers during the last ten years. It appears that e least thickness of oil which produces an appre-able effect on the surface tension of either water or ercury is much less than has been supposed. If a lm of oil the thickness of which is known from its olume and area, is gradually thinned by increase of s area, the surface tension of the surface it covers as the value appropriate to oil until the thickness of e film, $1{\cdot}10\times10^{-7}$ centimetre, is less than the mean ameter of an oil molecule, $1{\cdot}13\times10^{-7}$ centimetre, as termined by M. Perrin's method. Below this thickness the film of oil does not affect the surface tension of either water or mercury.

THE February number of the Journal of the Institution of Electrical Engineers contains the lecture on permanent magnets which Prof. Silvanus P. Thompson delivered at the meeting of the institution at Glasgow last year. It occupies more than sixty pages, gives a complete account of present-day knowledge on the subject, and points out directions in which further research is necessary. The author shows that the most powerful and permanent m steels with about 6 per cent. of cent. of carbon, and have the ra large. After forging at ture as possible the magnets to 900° C., cooled to 750° for a time, and then cooled is a repetition of this process down which temperature the magnets are to brine at 20° C. Maturing is done by boiling the mag nets for ten or twelve hours. Magnetisation effected by an electromagnet, and there is some advan tage in a few reversals. For extreme constancy th magnetisation may be reduced by 5 or 10 per cent. b subjecting the magnets to demagnetising forces. Th paper includes a bibliography which will prove o great use to future workers in this field.

MR. H. G. SEAGER, of Colwyn Bay, has devised an "automatic control" for aëroplanes, which appears well suited for the purpose of extricating an aviator from the difficulties in which he is placed by a sudden change of the conditions of either longitudinal or lateral equilibrium, such as that due to a gust of wind or a stoppage of the engines. *It is perhaps not sufficiently realised that the initial effect of the latter* cause is exactly represented by impressing on the machine a wrench equal and opposite to that of the propeller in steady motion, and, if the propeller is much below the centre of gravity the result will be to turn the whole machine round until the air strikes on the top of the planes and sends the aëroplane to earth. Mr. Seager employs a pendulum, so arranged that any finite displacement exceeding a certain limit operates one or more air valves controlling pneumatic motors, and these displace the controls through a finite distance proportional to the number of valves operated on, this number depending again on the displacement of the pendulum. The arrangement has the obvious advantage that the pendulum oscillations can be damped out by friction, so that the apparatus can be adapted to an inherently stable aëroplane without interfering with its motion or control except in the case of large disturbances.

IN "Untersuchungen über die Gezeiten der feste Erde und die hypothetische Magmaschicht," a recent publication of the Geodetic Institute at Potsdam, Dr. W. Schweydar has made a very important contribution to the investigation into the nature of the earth's interior. His discussion of a long series of horizontal pendulum experiments throws considerable light on the outstanding difference between the coefficient of rigidity for the earth indicated by the Chandler motion

of the pole and that given by tidal terms of long period. Consideration of the effects of ocean tides (discussed according to the dynamical theory) upon the semi-diurnal deformation of the solid earth gives the value for the rigidity of the earth as being two or three times that of steel. This value is of the same order as is required to account for the observed wandering of the pole, and also for the diurnal tide in the solid earth. Dr. Schweydar does not set much store by Dr. Hecker's differing results for the values of the east-west and the north-south elasticity, and he gives reasons for not accepting the explanations offered by Hecker and Lallemand. On one other debatable point of much importance Dr. Schweydar's results will be read with much interest. If the earth is to be regarded as consisting of an elastic core, a viscous layer, and a rind, then he decides that this viscous layer cannot be supposed to be of the fluidity of molten metal, but must be regarded as to all practical purposes solid. It need scarcely be stated here that this was the view reached on quite other grounds by the late Sir George Darwin.

IN two papers published in the *Atti R. Accad. Lincei* (vol. xxxi., ii., pp. 740 and 803) Profs. R. Nasini and C. Porlezza describe the discovery for the first time of ozone in a natural water, and discuss the possible reasons for its presence therein. The water is that of Le Bagnore of Santa Fiora, in Monte Amiata, and the ozone is not a transitory but a permanent and normal constituent, imparting a distinct odour to the water, and being present to the extent of about 0·15 c.c. per litre. The water is not radio-active, and in default of other possible explanations, the view is put forward that the presence of ozone is due to autoxidation of ferrous bicarbonate, either *per se* or brought about by the action of the so-called iron-bacteria. The water of a spring at Bagnoli, Arcidosso, also in the Monte Amiata district, possesses similar properties, but in a minor degree. Both these waters have locally a high therapeutic reputation, and the question arises whether this is due to the ozone which they contain. Further investigations will be made to decide this and other points as to which there is still some uncertainty.

WE have received a copy of the Transactions of the English Ceramic Society, part ii., session 1911–12, which, in addition to a number of papers of technical interest to potters, contains an account, which is of more general interest, of several of the principal pottery works on the Continent. In the summer of 1912 members of the Ceramic Society made a tour of inspection of ceramic works in Holland, Germany, and Belgium, and a report of the visit, admirably illustrated by photographs, covers forty pages of the Transactions. The descriptions given of the Royal Berlin Porcelain Factory at Charlottenburg, founded by Frederick the Great in 1763, and now carried on the Prussian Government, with 660 workmen, and he Royal Porcelain Factory at Meissen, founded 10, and now employing 800 hands, are of par- interest. The writer of the report expresses no such institutions exist in England:— should a manufacturing potter have an idea which, through lack of capital or initiative, he is unable to work out to fruition, he at once has the assistance of the State pottery to test, and, if necessary, to evolve that idea, whereas in England brains can only be utilised apparently to the accompaniment of capital and risk."

A MEMORIAL portrait of the late Capt. Scott in uniform has been published by Messrs. Maull and Fox, the proprietors of the copyright in the only photographs of the explorer in full-dress uniform. The portrait, which is a photogravure, has been approved by Lady Scott, and the publishers have undertaken to contribute an agreed proportion of the profits of the sale of the portrait to the National Fund which is being raised. The price of the portrait is 5*s*. each, and copies can be obtained through the usual trade channels, or from Messrs. Maull and Fox, 187 Piccadilly, London, W., or Messrs. S. Hildesheimer and Co., Ltd., 96 Clerkenwell Road, London.

OUR ASTRONOMICAL COLUMN.

SPECTRUM OF THE PLEIADES NEBULA.—Bulletin No. 55 of the Lowell Observatory contains an interesting account of the results secured by Mr. Slipher in the photography of the spectrum of the nebula in the Pleiades. This nebula, as Mr. Slipher points out, would doubtless naturally be classed as a gaseous nebula since in its prominent characteristics it resembles more the great nebula in Orion, the typical gaseous nebula, than the more numerous class of spiral nebulæ. However, with the 24-in. refractor of the Lowell Observatory he made an exposure of twenty-one hours, obtaining, as he states, a perfectly legible record. This spectrum was continuous and crossed by strong hydrogen lines, $H\beta$, $H\gamma$, $H\delta$, $H\epsilon$, and $H\zeta$, and fainter helium lines, those at 4026, 4381, and 4472 (combined with 4481) being recognisable. No trace of any of the bright lines seen in the spectra of gaseous nebulæ was found, but the spectrum resembled a copy of the brighter stars of the Pleiades. The result suggested that the spectrum might be due to light from Merope scattered and reflected by the large objective. Exposures on the nebula of Orion and of a region near Sirius, led him to conclude that "the nebula shines by light, the spectrum of which is a true copy of that of the neighbouring star Merope and of the other bright stars of the Pleiades." It is suggested then that the nebula is disintegrated matter similar to what we are acquainted with in our solar system, as in the rings of Saturn, comets, &c., and that it shines by reflected light.

CHROMOSPHERIC (SOLAR) LINES IN THE SPECTRUM OF ϕ PERSEI.—An interesting paper by Mr. Paul W. Merril forms part of Lick Observatory Bulletin No. 224. In the course of a survey of Class B stars having bright hydrogen lines, the author has measured a number of lines, bright and dark, between $\lambda\lambda$4340 and 6515 in spectrograms of this star, and connects these lines with "chromospheric" lines taken from Young's lists in Frost-Scheiner's "Astronomical Spectroscopy." It is to be regretted that the author has not employed a more recent authority. However, he considers the presence of "chromospheric" radiations in the stellar spectrum established. The star does not duplicate the solar chromosphere, for it is stated that the phenomena presented by helium, magnesium, and sodium are anomalously at variance with the chromospheric spectrum. This paper extends and confirms, apparently unconsciously, the conclusion previously arrived at by Sir Norman Lockyer and

Mr. F. E. Baxandall (Proc. Roy. Soc., vol. lxxiv., pp. 548–550, 1905), when many lines in the emission spectrum of μ Centauri (also an Orion star with bright hydrogen lines) were found to agree in wavelength with enhanced iron lines.

WHAT BECOMES OF THE LIGHT OF THE STARS?—This question Prof. Very, of the Westwood Observatory, Mass., U.S.A., places before the readers of *The Popular Science Monthly,* and proceeds to give an interesting answer in an essay, highly speculative in character, developed in eighteen pages of the March number. The author ably marshals a useful body of evidence tending to establish that there is a general absorption of light by the ether. In this transformation of energy he sees the genesis of matter, and in meteorites he finds the "appointed instruments" whereby the nascent dust is collected "into the germs of future worlds." By atomic disintegration like that accompanying the degradation of radio-active elements the cosmogonic process is made reversible.

It may be mentioned that in reference to the "transient nebulosity," which appeared around Nova Persei, the author states: "It was an electric phenomenon, an exhibition of canal rays, or positive ions, on a grand scale," and that to explain the high temperature of the helium stars, he makes the hypothesis that they "contain an exceptional amount of peculiarly unstable elements."

PUBLICATIONS OF THE STRASSBURG UNIVERSITY OBSERVATORY.—The second part of vol. iv. of the *Annalen der Kaiserlichen Universitäts-Sternwarte in Strassburg,* published under the direction of Dr. Bauschinger, contains a large number of observations of double stars, planets, satellites, and nebulæ. The double stars were observed with a 49-cm. refractor by Dr. Wirtz between 1902 and 1910, and the results are compared with those obtained by other observers and with the ephemerides. The same observer is also responsible for the measures of the major planets and their discussion, in which are given the diameters and other measures, such as the dimensions of the Martian snowcaps, and the positions of the *streifen* on Jupiter; for the polar and equatorial diameters of the latter planet he finds the values $35{\cdot}986'' \pm 0{\cdot}028''$ and $38{\cdot}254'' \pm 0{\cdot}030''$ respectively.

TIDE TABLES.—From the Government Astronomer of New Zealand, Mr. C. E. Adams, we have received a report of the tide observations made at Auckland since December 1, 1908. These have now been harmonically analysed, and the results are given. There is also an interesting description of a new tide gauge designed by Mr. W. Ferguson, in which the recording pencil is moved by a clock and the paper on which the record is made is moved by the tide. The gauge has been running some months, and has given great satisfaction.

From the Government Printing Bureau at Ottawa we have received copies of the tide tables for the Canadian coast for 1913. The accompanying letterpress contains many interesting facts concerning the tides on the Pacific coast.

STARS WITH VARIABLE RADIAL VELOCITIES.—Mr. J. H. Moore, of the D. C. Mills Expedition's Observatory, Santiago, Chile, gives a list (L.O. Bulletin 224) of nine stars of about 5·0 magnitude, having variable radial velocities. In the same bulletin Prof. W. W. Campbell gives observations showing that the radial velocities of δ Andromedæ and μ Cephei respectively vary between −1·8 km. and −10·8 km., and +15·6 and +29·4. The latter also makes a correction regarding the radial velocity of ι Capricorni. In L.O. Bulletin 97 this was stated to be variable. The removal of some errors of reduction leaves the velocity apparently constant at +12 km. per second.

THE TEACHING OF MATHEMATICS.[1]

THE papers enumerated below complete those written for the recent International Congress of Mathematicians. They deal with secondary schools, girls' school, preparatory schools, the training of teachers, technical institutes, and universities. Earlier papers in the same series were described in NATURE of March 14, 1912 (p. 44), and of May 23 (p. 305).

Secondary Schools.

No. 20 is a judicial discussion of "The Calculus as a School Subject." Mr. Jackson states impartially the questions involved, some of which can only be settled by greater experience than we now possess. Some questions are already settled, *e.g.* that if the calculus is to be introduced time must be found by a reduction in the drill which now prevails in algebra and trigonometry, by a frank recognition that tangents to curves and varying velocities involve the ideas of the calculus with some knowledge of the concrete ment that follows from this recognition. It is also desirable that the pupil should come to the study of the calculus, and by giving these subjects the treatmatters to which its methods are applicable. Mr. Jackson appears to be unaware that it is useless to point out an imperfection of proof to pupils who cannot discover the imperfection for themselves; but his pedagogy is in general so good that we feel sure he does himself injustice in this apparent ignorance.

Mr. Barnard (No. 22) frankly disapproves of the methods of teaching which have resulted from Prof. Perry's movement. He is all for thoroughness, and most of his article is taken up with a list of the blunders of text-books. We gather that he attributes these blunders to the new methods, a surprising view when we consider how few men educated in the new methods are old enough to write books.

Our conclusion is different. Writers of text-books are on the whole picked men, such as university professors and the ablest schoolmasters, and they are at present men trained on the old "thorough" methods; and if such blunders are possible for these picked men, it is indeed few of the schoolboys who are fit to profit by that training.

[1] The Teaching of Mathematics in the United Kingdom. Special Reports on Education Subjects.

No. 18. "Mathematics in the Education of Girls and Women." By Miss E. R. Gwatkin, Miss Sara A. Burstall and Mrs. Henry Sidgwick. Price 2½*d.*

No. 19. "Mathematics in Scotch Schools." By Prof. G. A. Gibson. Price 3*d.*

No. 20. "The Calculus as a School Subject." By Mr. C. S. Jackson. Price 1½*d.*

No. 21. "The Relation of Mathematics to Engineering at Cambridge." By Prof. B. Hopkinson. Price 1½*d.*

No. 22. "The Teaching of Algebra in Schools." By Mr. S. Barnard. Price 1½*d.*

No. 23. "Research and Advance Study as a Training for Mathematical Teachers." By Prof. G. H. Bryan. Price 1½*d.*

No. 24. "The Teaching of Mathematics in Evening Technical Institutions." By Dr. W. E. Sumpner. Price 1*d.*

No. 25. "The Undergraduate Course in Pass Mathematics, generally, and in relation to Economics and Statistics." By Prof. A. L. Bowley. Price 1½*d.*

No. 26. "The Preliminary Mathematical Training of Technical Students." By Mr. P. Abbott. Price 1½*d.*

No. 27. "The Training of Teachers of Mathematics." By Dr. T. P. Nunn. Price 1½*d.*

No. 28. "Recent Changes in the Mathematical Tripos at Cambridge." By Mr. A. Berry. Price 1½*d.*

No. 29. "Mathematics in the Preparatory School." By Mr. E. Kitchener. Price 1½*d.*

No. 30. "Course in Mathematics for Municipal Secondary Schools." By Mr. L. M. Jones. Price 1½*d.*

No. 31. "Examinations for Mathematical Scholarships at Oxford and Cambridge." By Mr. A. E. Jolliffe and Mr. G. H. Hardy. Price 2*d.*

No. 32. "Parallel Straight Lines and the Method of Direction." By Mr. T. James Garstang. Price 1*d.*

No. 33. "Practical Mathematics at Public Schools." By Prof. H. H. Turner, Mr. R. C. Fawdry, Mr. A. W. Siddons, Mr. F. W. Sanderson, and Mr. G. M. Bell. Price 1*d.*

No. 34. "Mathematical Examinations at Oxford." By Mr. A. L. Dixon. Price 6*d.*

(London: Wyman and Sons, Lt Edinburgh: Oliver and Boyd; Dublin; E. Ponsonby, Ltd.)

Even Chrystal blundered; he is the only blunderer whose name is given by Mr. Barnard. Chrystal's was the last and greatest attempt to do for algebra what Euclid attempted for geometry, to build up the whole structure on a few axioms the truth of which was obvious. As the result of his attempt Chrystal learned (and was always ready to admit) how impossible of attainment this ideal is, a conclusion which is to-day becoming generally accepted. In the future, instead of trying to build mathematics up on axioms which are absolutely fundamental and by reasoning which only a genius is fit to grasp, we shall use as the foundation properties which are intelligible to every boy, we shall assume the truth of these whether obvious or not, and upon these we shall build the superstructure. The question of the soundness of the foundation is not a question for schoolboys, it is not even a question for the average university student, it is a question of metaphysics to be dealt with by the mathematical philosopher.

No. 30 is an account by Mr. L. M. Jones of the work in a municipal secondary school. The course is good, and ends with the calculus. It includes here and there an item on the value of which all would not agree, *e.g.* stocks and present value, solution of a quadratic by guessing factors, and the use of the straight line graph as introduction to graphs and the calculus. A sound opinion of Mr. Jones's, which one would like to see more widely adopted, is that the time spent in arithmetic on contracted methods is out of proportion to its value to the pupil, it being quicker and surer in most natural questions to use all the figures given than to contract.

In No. 32 Mr. Garstang attempts to pile up a load of wickedness on the Board of Education. He charges Circular 711 with loose reasoning in the matter of parallels, and quotes many authorities to show that a rigorous development cannot be based on the method of direction. But the withers of the Board are unwrung. It is the second and third stages of the Circular which deal with the systematic development of geometry; the first stage, containing the passage which displeases Mr. Garstang, is not concerned with rigorous development, but with the preliminary acquisition of the concepts of the subject.

At Oundle (paper No. 33) the data for practical mathematics are supplied from "the school shops, testing-rooms, and fields." This is admirable, and the boys show a keenness about the results because of their contact with reality, a keenness much greater than is aroused by questions which are only of academic interest to the pupils, however practical and important they may be for men or for other boys. A difficult problem for schools less fortunately situated than Oundle is the invention of laboratory questions which have real interest and importance for the boys to whom they are set.

No. 19 is a clear exposition by Prof. Gibson of mathematics in Scotch schools, which must have been of great value to members of the congress who were investigating such matters.

Preparatory Schools.

Paper No. 29 contains a pleasing sign of the times in the cooperation of public and preparatory schoolmasters. In former years a preparatory school had to prepare boys for a great variety of scholarship examinations, and a public school to continue the education of boys taught on a great variety of plans. To obviate the consequent difficulties, representatives of the Headmasters' Conference and the Association of Preparatory Schools have drawn up a syllabus for a boy's education in mathematics from nine to sixteen. This syllabus is now pretty widely used; it also bears witness to the advance made in recent years in the teaching of the subject.

Training of Teachers.

In No. 27 Dr. Nunn discusses the training of teachers of mathematics. Perhaps the most interesting part of his paper is his excellent syllabus of mathematical studies. The first part of the syllabus is compulsory, and includes numerical trigonometry and the ideas of the calculus. It is arranged with the object of giving a clear consciousness of mathematical conceptions. The logical proofs of these conceptions belongs to the second part, which is optional. The introduction to the calculus is made on historical lines, on which lines it is interesting to note that integration preceded differentiation.

One would like to see logarithms also follow the historical order, and introduced in Napier's way, without any consideration of indices. Dr. Nunn's method compels the treatment of negative and practical indices in part i., for which they are too difficult. But it is perhaps ungenerous to criticise a detail in a scheme drawn on such broad and statesmanlike lines.

Technical Institutions.

Nos. 24 and 26.—Most teachers of mathematics have their pupils at their mercy. In evening technical institutions we meet a new type, the youth who must be persuaded to come in. It is interesting and important that while mathematics treated in an abstract way deters him, the subject treated in connection with (and arising out of) concrete problems related to the boy's work not only persuades him to come in, but often gives him such an interest that he goes on with the abstract study.

Mr. Abbott also contributes the valuable suggestion that each locality should have an advisory committee composed of teachers of elementary schools, evening continuation schools, secondary schools, and technical schools, for the coordination of the work of these schools in regard to the preliminary training of technical students.

Dr. Sumpner and Mr. Abbott agree in the statement that students who come from elementary schools require much training in accuracy. There is clearly still room for reform in the mathematical teaching of these schools, when it is still necessary to recommend the abandonment of "discount, stocks and shares, H.C.F. and L.C.M., &c.'

Universities.

In Nos. 21, 23, 25, 28, 31, 34, we have the views of the universities. Various changes are advocated, a reduction of the degree of analytical skill now required, an extension of the range of mathematical studies, closer connection with other subjects, more regard for after-careers, encouragement of original research. Recent reforms in school mathematics sometimes meet with approval, sometimes with disapproval. Oxford and Cambridge are working, in their examination regulations, towards a greater range and less analytical skill; Cambridge also towards meeting the needs of students of physics and engineering.

Prof. Bryan deplores the indifference of the practical man to the value of mathematics. Of this indifference there is no doubt, or of the fact that the practical man frequently meets a problem in which the mathematician could help him. The engineer has an outfit of mathematical tools sufficient for his

ordinary needs, but at times he meets a problem for which his tools are useless. He may then spend thousands of pounds on the determination of some point which the mathematician could have settled for a five-pound note. Instead of collaborating, the practical man and the mathematician scorn one another with an equal scorn, and indulge in pin-pricks when they happen to meet. It seems to us that it is for the mathematicians, who are seeking admission into the practical man's sphere, to hold out the olive branch, to go to him and say:—"Yes, we have often given you reason for thinking us fools. But we think we can really help you this time. Only let us try; if we fail, you are no worse off than before."

Education of Girls and Women.

No. 18 contains three papers by Miss Gwatkin, Miss Burstall, and Mrs. Sidgwick. Miss Gwatkin gives an effective statement of the advantages to be gained by a girl from the study of mathematics. We fear, however, that these advantages can only be attained by exceptional girls, and that for the average girl it is an attempt to turn a good girl into an inferior boy, to implant masculine virtues in place of developing the feminine ones. We could wish that Miss Gwatkin had supplemented her statement by an estimate of the relative advantages to the girl of mathematics and of possible alternative studies.

In the same paper Miss Burstall shows, in a historical sketch, the chance wind by which mathematics was introduced as a necessary element in the secondary education of girls, and then proceeds to inquire how far it is appropriate there. She is in general agreement with the present tendency to give an occupational turn to school studies, and points out how little connection mathematics has with the life of the bulk of women.

Miss Burstall divides girls into three classes. At one end of the scale is the small number with a real taste for mathematics. For these the subject is an admirable training, provided the danger of "narrowness, hardness, ossification," is avoided by requiring a concurrent training in English literature or some other literary subject.

At the other end of the scale come a number of girls who cannot do mathematics at all, or only with an enormous expenditure of energy. The teaching of these she compares to the laboratory manufacture of diamonds, the cost of production being quite out of proportion to the value of the resulting article.

Between these two extremes lie the bulk of the girls. For them mathematical training has value, but the same attainment must not be expected of them as of boys. The importance of other subjects and the girl's total energy-supply have to be considered. They should study mathematics for two or three years and get what value they can from the study, but the assessment of results by examination should not be forced on every girl. In school-leaving and college-admission examinations the necessary guarantee of austere intellectual effort can be secured by making Latin or an appropriate treatment of Harmony alternative with mathematics.

In a short and eloquent paper on university mathematics for women, Mrs. Sidgwick maintains that "there is no need to consider the case of women separately from that of men," and that while "in planning a scheme of general education regard must be had to the probable future work of the learners, a subject which is studied not for its own sake, but because it is useful for something else, is almost always degraded in the process, and loses much of its educational value."

DAVID BEVERIDGE MAIR.

THE RUSTING OF IRON.[1]

IN the October issue of the Chemical Society's Journal, Mr. Bertram Lambert describes a second series of experiments on the rusting of iron. In these experiments it is shown by spectroscopic examination that carbon dioxide was actually present under the conditions used previously. Elaborate care was therefore taken to remove this, by heating as much as possible of the apparatus, whilst maintaining a high vacuum, and (during some of the successive heatings) cooling an attached tube in liquid air. The spectroscopic indications of carbon dioxide disappeared after the first of eight successive heatings, but no change was noticed in the readiness with which commercial iron rusted in the apparatus when purified oxygen and purified water were admitted. The author maintains, therefore, that these substances are capable of bringing about rusting in the absence of any trace of carbonic or other acid. The contrast between these results and those observed by Moody and by Friend is attributed to "passivity" induced in the metal in the one case by treatment with chromic acid (as suggested by Tilden), and in the other case by treatment with caustic soda (as suggested recently by Dunstan and Hill). This passivity must evidently be supposed to be permanent during many months of contact with air and water, but to be destroyed immediately by the merest trace of carbonic acid or by contact with glass.

An interesting account is given of the properties of pure iron as prepared by the methods previously described by the author, in which ferric nitrate is obtained so perfectly free from manganese that it no longer shows the violet colour which usually characterises the salt, and is then decomposed in iridium vessels, so as to avoid all risk of contamination with platinum. The metal so prepared is permanently resistant to rusting, even in contact with common air and common water. It does not dissolve in cold dilute sulphuric and nitric acids, but dissolves readily when the acids are heated. Hydrochloric acid dissolves the metal even in the cold. A similar contrast is noticed in the behaviour of the salts; the metal does not rust when exposed to air in presence of sodium, potassium, or ammonium sulphate or nitrate, but undergoes corrosion in a few hours when transferred to a normal solution of one of the chlorides. Again, pure iron will withstand the action of a saturated solution of copper sulphate or copper nitrate at the ordinary temperature for an indefinite time, without losing any of its lustre and without any perceptible trace of copper being deposited; but if a concentrated solution of copper chloride is used, the iron becomes coated with copper immediately it is put into the solution, and, within a few minutes, the iron all disappears, and only finely divided copper remains. The behaviour of the pure metal is here very similar to that of commercial aluminium.

The resistance of the purified metal to corrosion and to dissolution is probably due to the homogeneity of its surface, since if this is destroyed by pressing the metal with an agate pestle in an agate mortar the metal begins to corrode in less than an hour, rust being deposited on the unpressed parts of the metal whilst the pressed parts remain bright. In the same way copper is deposited on the iron if it is pressed in an agate mortar before being put into a solution of copper sulphate, or if it is pressed with a quartz rod while under the copper sulphate solution.

As a rule iron which will not rust will not deposit copper from the sulphate, and conversely; but in one

[1] See NATURE. 1911, vol. lxxxvi., p. 25.

case an interesting exception was observed. A piece of iron which had not rusted on long exposure to the action of air and water was placed in a strong solution of copper nitrate; after some time beautiful crystals of copper were deposited on parts of the iron, whilst other parts remained quite unaffected.

SOUTHERN HEMISPHERE SEASONAL CORRELATIONS.

THE first of a proposed series of articles on this important subject by Mr. R. C. Mossman, of the Argentine Meteorological Office, appears in *Symons's Meteorological Magazine* for February. Notwithstanding the great labour involved in this kind of research, it has received increasing attention from leading meteorologists during recent years. Mr. Mossman has collected a large mass of material relating to the climate of South America, which is now available for testing whether the sequences of weather in that continent "show as pronounced resemblances or contrasts, when compared with data from other regions, as do those in the northern hemisphere."

The inquiry now in question refers to the relation between the Nile flood and the winter rainfall of Santiago (Chile). The data used for the Nile floods are the percentage values for the years 1869–1906, published by Captain Lyons in "Rains of the Nile," 1906, and, for rainfall, the percentage values at Santiago for May–August of the same years. When plotted on a diagram, it is seen that, on the whole, there is a strongly pronounced opposition between the two sets of values. The author points out that the winter rainfall of Santiago, in common with other stations between 32° and 39° S., varies with the position of the South Pacific high-pressure area.

The Chilean Meteorological Office has recently supplied a complete set of instruments to Juan Fernandez, and the island is in radiographic communication with the mainland. This, with observations from a new station on Easter Island (27° S., 109° W.), should, Mr. Mossman thinks, afford useful information regarding the seasonal relations of the South Atlantic and South Pacific anticyclonic belts, and later on, when these data are compared with those at St. Helena, there is little doubt that the chain linking up the rainfall of Abyssinia with the Antarctic circulation will be complete. Captain Lyons has shown that the height of the Nile flood is dependent on the June to September rainfall in Abyssinia.

SOME METHODS OF MAGNIFYING FEEBLE SIGNALLING CURRENTS.[1]

TELEGRAPHY over long submarine cables is continually on the increase, and I think it may be brought forward as a fairly accurate statement that the number of messages sent doubles itself every ten years. It is therefore important that, besides the increase in the number of the cables laid down each year, means should be devised to increase the carrying power.

The instruments which I have invented and am about to describe were designed primarily for cable work, but they are equally applicable to recording many other kinds of signalling impulses.

For good reasons, recording by photographic means is objected to by nearly every telegraphist. If the photographic method were permissible, great advances in speed would be available, but it is important that the record should be of a simple, cheap, and immediate nature.

Lord Kelvin invented the siphon recorder in 1867 —that is, about forty-five years ago; he designed it so carefully that no improvement in its sensitiveness has been brought about until now.

Short Siphon Recorder.

In siphon recorders of the moving-coil type what has to be done consists of—

1) Overcoming the inertia of the coil and siphon.
2) Overcoming the back E.M.F. of the coil.
3) Overcoming the control of the suspensions.
4) Overcoming the friction of air, suspensions, and inking.

As the siphon has to return to zero in a certain time after the current in the coil ceases, it is necessary for the coil and siphon to have a definite frequency of oscillation depending on the speed of the signals. For submarine telegraphy this frequency lies between about 3 and 10 per second, and is adjusted by varying the control on the coil. As the control necessary to give a certain natural period to the moving system is proportional to its moment of inertia, it follows that by reducing this inertia we reduce the forces required both to accelerate the coil and to overcome the control.

The ordinary siphon recorder employed is a siphon tube about $2\frac{1}{2}$ in. long and from 8 to 12 mils in

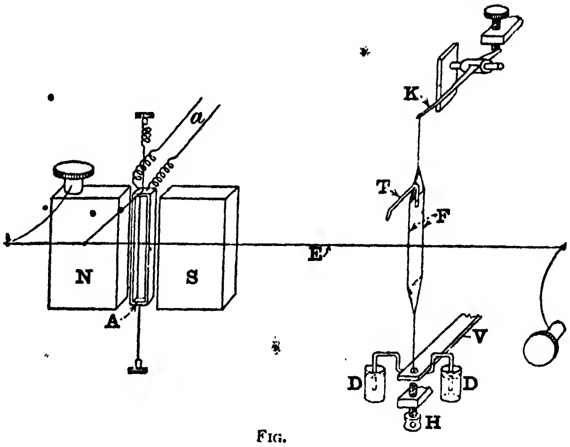


FIG.

diameter. The moving coil consists of 500 turns of 2-mil wire at a mean radius of $\frac{3}{8}$ in. The coil and siphon are mounted on separate axes and are connected by silk fibres so that the angular movement of the siphon is about two to three times that of the coil. By reducing the length of the siphon to $\frac{1}{2}$ in. and substituting a narrower coil it is possible greatly to increase the sensitiveness of the recorder.

In order to make the inertia effects of the moving system a minimum, it is advisable to make them equal for the coil and the siphon. Even a narrow coil of 300 turns has about 100 times more inertia than the siphon, so that it is necessary to move the siphon through $\sqrt{100}$ times the angle moved by the coil.

By reducing the number of turns on the coil and increasing the field it is possible to reduce the natural period for a given sensitiveness and back E.M.F., but as the mass of the mountings and insulation of the coil only decrease slightly as the turns are reduced the gain is not very marked. In practice it is inadvisable to reduce the turns on the coil below 50 or 100 turns, as with lower values the power required to overcome the friction of the

[1] Discourse delivered at the Eighth Exhibition of Apparatus, held by the Physical Society on December 17, 1912, by Mr. S. G. Brown.

air and inking becomes too limited. This precludes the possibility of attaching the siphon directly to a coil of a few turns, and means of magnifying the motion of the coil and transmitting it to the siphon have to be used. In this instrument (Fig. 1) it is accomplished by means of a fine fibre, E, which is kept in tension by flat springs at each end. The fibre is attached to an arm carried by the moving coil A, and to a vertical fibre, F, on the siphon suspension.

The siphon is carried on an aluminium carrier to which a single central fibre is attached at the top and two parallel fibres, FF, 0·2 in. apart below. One leg of the siphon (Fig. 2) lies on the axis of the suspension and dips into a small opening in a pipe extending from the ink-pot. This arm goes in between the two vertical fibres, and as the opening in which the siphon dips is only a small one, the ink level remains practically constant, whether the reservoir is full or not. The siphon turns round on the axis in which the leg lies, and this makes the drag between the moving siphon and the ink very much less than if the siphon cut across the surface of the ink.

In order to produce an ink line on the paper without introducing friction, the siphon must not touch the paper even momentarily, and arrangements have been made to jerk the ink in fine drops on to the paper. To accomplish this the whole of the siphon suspension is vibrated rapidly up and down between the springs V' and K by means of the spring V, which is attached to the vibrator. As the spring V is very weak in comparison with the reed, the vibrations of the latter are not affected by the movements of the spring. To impart a jerk to the siphon a stop, H, is fixed directly under the axis of suspensions, and two little dash-pots, DD, on either side prevent the spring bouncing on the stop.

The working end of the siphon is ground flat, and an aniline dye with a small proportion of methylated spirit or ordinary red ink is used for recording on the paper. In this way a fine line of very closely spaced dots can be obtained without introducing any appreciable drag on the siphon.

For signalling purposes, the distortion due to the radius of the siphon being only ½ in. is not at all troublesome as the velocity of the paper moving round the wheel R masks this.

When the instrument is adjusted to have a natural frequency of 10·5 per second, with a 300-ohm 300-turn coil, a current of 50 microamperes gives a full-sized signal corresponding to a deflection of 0·1 in. on the paper. Under these conditions the back E.M.F. of the coil is only about one-quarter to one-fifth of that of the ordinary recorder coil.

Trials with this instrument have shown an increase of speed of 30 per cent. on the largest Atlantic cables.

Thermoelectric Magnifying Relay.

In this instrument (Fig. 3) the power in the relay circuit is generated by means of five thermo-junctions at different temperatures. The heat is supplied by two little flames, CC, and a very light thermopile, B, is suspended so as to swing in and out of the flames, and is coupled to a moving coil through which the received currents pass.

The thermopiles consist of alternate junctions of platinum and platinum + 20 per cent. iridium, wires being used of 1 mil diameter. The joints are made by twisting the ends of the two wires together and holding the junctions in a Bunsen flame for a short time. In this way a perfectly good and permanent joint is ensured. The wires are melted on to a fine glass tube about 10 mils in diameter, and one connection is brought down inside the tube to the first junction and the other connection comes along the outside of the tube.

For moving the thermopile in the flames similar arrangements to those just described for the siphon recorder are employed. Under the saddle which carries the thermopile the two silk fibres are stretched, and on to one of these the cross fibre which transmits the movements of the coil to the thermopile is attached. The top and bottom suspensions are of fine phosphor bronze wire and serve as leading-in wires to the thermopile.

To supply the heat two little flames are fed by two or three strands of cotton wick with alcohol or methylated spirit. If the wick just protrudes above the opening a small steady flame is produced, and the lamp is provided with adjustments to vary the distance between the flames and the position of both flames relative to the thermopiles.

Instead of burning directly on the lamp wicks, a simple vapour burner can be fitted which will give good results even with very impure spirit. This consists of a brass cap which is kept hot by a copper wire attached to it at one end, and is heated at the other end by the flame. By altering the amount of wire in the flame the size can be varied.

An alternative arrangement which gives greater sensitiveness and enables heavier thermopiles to be used is to fix the thermopiles and vary the flames by means of a valve or shutter actuated by the coil movements.

As the thermopile current depends on the difference of temperature between the junctions a certain time is required to heat the wires. It is found that for cable work, where the frequency seldom exceeds

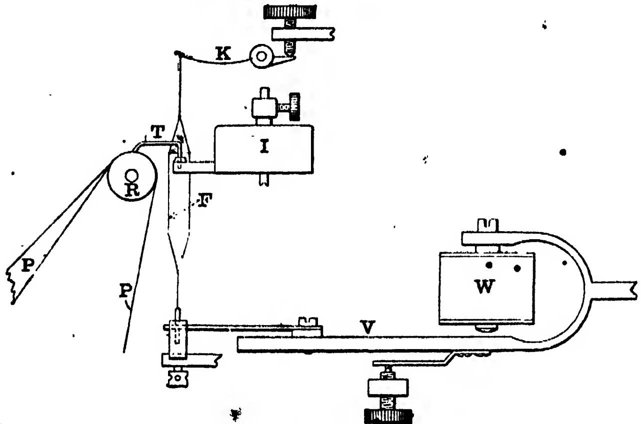


FIG. 2.

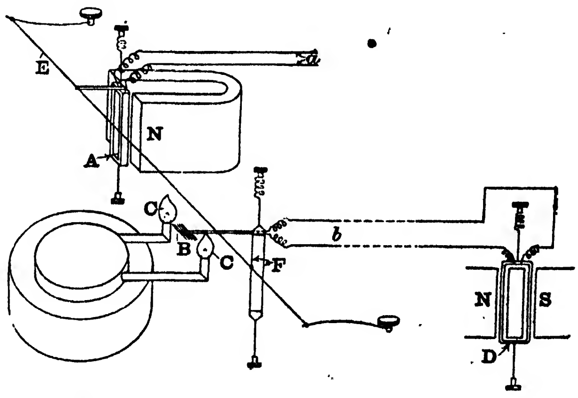
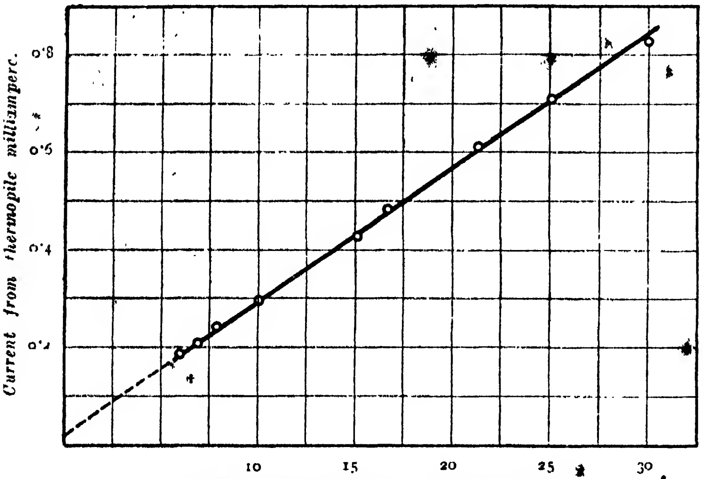


FIG. 3.

10 per second, the lag is inappreciable, but for considerably faster movements it becomes important.

In duplex working when the sending current has to be balanced so as not to affect the receiver, quick, "jarry" movements are very difficult to eliminate, but the lag in the thermo instrument reduces these movements very considerably and is a valuable property.

When the thermopile is in its central position and no current is flowing both junctions are at a dull red heat, and when fully deflected one junction becomes bright red and the opposite one is black or very faintly

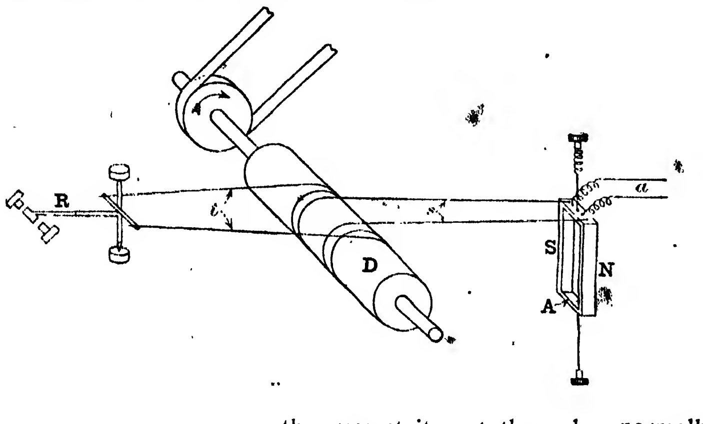


Current through moving coil microamperes.

FIG. 4.

red. In intermediate positions the current generated by the thermopile is nearly proportional to the deflection.

The curve (Fig. 4) was taken from a thermopile with seven junctions on each side. When the thermo-



the current it sent through a resistance of 42 ohms (equal to its own resistance) was 0·81 milliampere. With the natural period of the coil equal to 8·7 per second and a 480-ohm 480-turn coil, a current of 0·03 milliampere through the coil gave a current of 0·81 milliampere from the pile through an external resistance of 42 ohms. For slowly changing currents this corresponds to a magnification of power of about twenty-seven times, and, of course, this can be greatly increased by reducing the period of the coil. For quickly changing movements the power magnification is not so great, owing to the back E.M.F. of the coil.

Trials of this instrument on an Atlantic cable have shown an increase in speed of about 40 per cent.

Mechanical Relay.

The instrument just described is a magnifying relay—that is to say, it multiplies the impulses received in exact proportion to their strength. This form of relay is quite distinct from an ordinary make-and-break relay, which delivers a constant current for any impulse over a certain strength. For very many purposes it is essential that received impulses should be magnified without altering their shape, and this can only be done by an instrument with a constant magnifying power.

That this is the case in the thermo relay is shown by the diagram (Fig. 4), where the current supplied to the coil and the current delivered by the thermo-junctions are plotted. Within the range of the instrument the points lie on a straight line and represent, in this case, a constant magnification in current of about twenty-seven times.

This property I will now illustrate in an entirely mechanical relay in which movements operated by very small forces are largely increased in strength without affecting their motion. The relay consists in principle of a rotating spindle around which are wound one or more turns of a flexible cord. The spindle is revolving in such a direction as to pull away from the magnified forces and towards the small forces that control the movement. Suppose a heavy weight has to be raised by a force of one-tenth of the amount, it will obviously be necessary to supply 90 per cent. additional energy, and this is supplied by the motor driving the spindle. The magnification of force and energy depends on the number of turns which the cord makes round the spindle and follows a compound interest law.

In the model shown it will be seen that a large magnification of power can be easily obtained by very simple means. Thus I can move this 14 lb. weight rapidly up and down by pulling upon this silk fibre.

Fig. 5 shows an application of the principle to cable work, in which the small forces operating the coil A are intensified sufficiently to work the coarse relay arm R. The spindle rotates away from the relay arm R and towards the coil, and produces a much greater tension in the fibres t than in s. When the coil swings on its axis the tension is increased in one of the fibres and diminished in the other, and a similar change in a magnified degree takes place in the fibres t.

By using means of this sort it is possible to work an ordinary siphon direct writer which normally requires some 3 milliamperes by a current of 10 microamperes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A SUMMER School in Geography will be held at the University College of Wales, Aberystwyth, on July 28–August 16. Among the subjects included in the scheme of work are:—Human geography, Prof. H. J. Fleure; climatology and trade routes, W. E. Whitehouse; land forms and natural regions, E. S. Price; field classes and excursions.

THE Department of Agriculture and Technical Instruction for Ireland has now published particulars of the summer courses for teachers it has arranged to hold in July and August next. With few exceptions the courses will be held in Dublin. In July teachers will have the opportunity of selecting their study from a wide variety of subjects of experimental science and technology. In August, practical mathematics, rural science, and a number of domestic arts will be taught. These courses are open only to persons who are over twenty years of age, and, except in the case of the courses in rural science (including school gardening) and drawing and modelling, only to teachers who are engaged (*a*) by local committees of technical instruction; or (*b*) in schools receiving grants either directly from the department or under the provisions of an approved local scheme of technical instruction. Application to attend the courses must be made before April 15.

THE Education Committee of the West Riding County Council proposes to hold at the Training College, Bingley, in August next, a vacation course for teachers in secondary, technical, elementary, and other schools, beginning on August 5. The course will not be limited to West Riding teachers, but will be open to all on payment of the fees. The aim of the course is to stimulate teachers and to give them opportunities of studying new methods of teaching the various subjects rather than to give specific instruction in the subjects themselves. The subjects to be dealt with cover most branches of the curriculum, and include the following:—The teaching of practical arithmetic, Mr. J. R. Deeley; the teaching of handwork, Miss K. Steel; the teaching of domestic subjects, Miss G. E. Irons; physiology, Miss F. E. Relf; the teaching of experimental science, Prof. Arthur Smithells, F.R.S., and Mr. H. Calam; and nature-study, Miss Mary Simpson.

IN his report for the academic year ending June 30 last, a copy of which has reached us, President Ira Remsen, of Johns Hopkins University, refers to the inauguration of a school of technology in the University. The creation of a new department of the University has been made possible by an Act of the Legislature of Maryland, in its session of 1912. The sum of 120,000*l*. was granted for the construction and equipment of buildings for a school of advanced technology. A further continuing annual grant of 10,000*l*. was also provided for maintenance. The provisions of the Act include the granting of 129 free scholarships to residents of the State. These scholarships are apportioned to the various legislative districts, to seven colleges in the State, and six may be awarded at large. Among the numerous public lectures given in the University during the year, we notice a course of eight on solar and terrestrial physics, by Prof. A. Schuster, one by Prof. W. Paszkowski, of the University of Berlin, on the organisation and work of that institution, and four by Prof. W. L. Johannsen, of the University of Copenhagen, on heredity and variation.

LORD HALDANE gave an address on the problem of national education at the conference of the National Union of Teachers on Tuesday, March 25. He stated that he could not describe the details of the scheme proposed by the Government, but he could give his own views. In the course of his remarks he said:—"If we do not keep abreast in the training of the national mind with those other countries which are organising their education systems, and which in many respects are our superiors, it is inevitable that in these days, when science and knowledge are the conditions of all success, industrial and generally, we shall fall behind in the race. It is a question of national safety, and nothing else, with which we are dealing. I am sometimes very much concerned about our industries when I think of the backwardness of our educational system, but man does not live by bread alone, and we shall not get even a good technical education system unless we put it on a broad foundation of national education. The State has a deep and direct interest in seeing that its people are educated, just as it has in seeing that they are healthy. A national system must take cognisance of all the means by which education is provided in a country like this. The highest means, the lowest means, the university, the secondary and the elementary school—they must all be fitted into their place in one system. Ten years ago there were only six teaching universities, but since then five more have been established. Putting outside Oxford and Cambridge, the number of students working in the day time has doubled in the last ten years. The number of degrees obtained by students in England and Wales in 1911 is more than twice the number obtained in 1901. There are things which cannot be secured outside the atmosphere of the university. I can never admit that an external student is the same as an internal student. The internal student has matured his mind in the university atmosphere. The external student is working hard, but only for the external examination, and some people with much less aptitude than their neighbours in what is best in the realities of education have much greater aptitude in passing examinations. Therefore the external examination is not a real test of learning. The only real test of learning on which I should like to give a degree exclusively is the record of the student during his time at the university."

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, March 5.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—S. S. **Buckman**: The "Kelloway Rock" of Scarborough. The author has studied the types of ammonites from the Kelloway Rock described by Leckenby, preserved in the Sedgwick Museum, Cambridge, and a series of Yorkshire Kelloway-Rock ammonites from the Museum of Practical Geology, London. He has grouped these ammonites according to their different matrices, and finds that they indicate several different zones. These zones he arranges in sequence, and suggests how they may be compared with the sections of Kelloway Rock of Scarborough given by Leckenby and by Fox-Strangways. The exact order of the zones is, in one or two cases, not considered to be proved, but the paper is offered with the idea of indicating where further work is required.—L. F. **Spath**: Jurassic ammonites from Jebel Zaghuan (Tunis). Jebel Zaghuan, the best-known and most conspicuous, though not the highest, mountain of the Tunisian Atlas, is built up largely of massive bluish-grey limestones of confused stratification which have been referred to the Middle Lias on the evidence of badly preserved belemnites and Terebratulæ, notably "*Pygope*" *aspasia*, *Columna* sp. Middle Liassic (Domerian) ammonites are now recorded for the first time. A new classification of the Domerian genera, of the family Hildoceratidæ, to which the fossils from Jebel Zaghuan belong, is proposed. Moreover, the ammonites collected by the author afford sufficient evidence of the presence of the zone of *Reineckia anceps*, which occurs in Algeria, but had been supposed absent in Tunis, together with the other beds intervening between the Middle Lias and the Corallian.

CAMBRIDGE.

Philosophical Society, February 24.—Prof. Pope, vice-president, in the chair.—Prof. **Pope** and J. **Read**: The ten stereoisomeric tetrahydroquinaldinomethylene-camphors.—J. E. **Purvis** and A. E. **Rayner**: The chemical and bacterial condition of the Cam above and below the sewage effluent outfall. The river was investigated at various points extending from 100 ft. above the outfall and at 8 ft. from the outfall, and at ¼ of a mile, ½ a mile, ¾ of a mile, 1½ miles, 2 miles, 2½ miles, 3 miles, and 4 miles below the outfall. Chemically, the river purifies itself moderately well from the contaminating effluent, for at about three-quarters of a mile below the effluent, the albuminoid ammonia and the oxygen absorbed figures were lower than at 100 ft. above the effluent outfall. Bacterially, the dangerous pollution, as indicated by *B. coli*, is well marked at between three and four miles below the outfall. The potential danger of such contamination is in the direction of cattle quenching their thirst, of bathers, and of watercress.—F. E. E. **Lamplough** and Miss A. M. **Hill**: Some experiments on the slow combustion of coal dust.—F. R. **Ennos**: The oxidation of ferrous salts. Air or oxygen was bubbled through ferrous salt solutions and the rate of oxidation measured by withdrawing portions at known intervals and titrating with $KMnO_4$ or $K_2Cr_2O_7$. For the chloride, sulphate, and acetate the rates are approximately as 1 : 10 : 100, the reaction in the case the sulphate being proportional to the square of the rous salt concentration, and to the partial pressure he oxygen. The oxidation seems to depend on the ionised part of the ferrous salt molecule.—W. H. and Miss A. M. **Bain**: The optically active semi- ne and benzoylphenylhydrazone of *cyclo*- -4-carboxylic acid.—Dr. G. F. C. **Searle**: Ex- s illustrating "flare spots" in photography. ght from a point S falls on a simple thin lens length f, most of it passes through the lens ns an image of S. But some of the light two reflexions within the lens, and this light se to a second image of S of small intensity, esponding focal length being $(\mu-1)f/(3\mu-1)$, μ is the refractive index. This image is called e spot." When two lenses are used there are are-spot images of any object formed by twice cted rays and with t lenses there are $t\ (2t-1)$ such ages.—J. G. M. **Dunlop**: Effect of heating para-ormaldehyde with a trace of sulphuric acid. The author finds that in the preparation of α-trioxymethylene (Pratesi, Gaz., xiv., 139), by heating paraformaldehyde (trioxymethylene) with a trace of concentrated sulphuric acid in a sealed tube for some hours at 115° C., a considerable amount of the formaldehyde is converted to methyl formate.

PARIS.

Academy of Sciences, March 10.—M. P. Appell in the chair.—The president announced the death of M. Alfred Picard.—C. **Guichard**: A particular class of Moutard's equations.—Paul **Sabatier** and M. **Murat**: The direct hydrogenation of the hydrocinnamic esters; preparation of β-*cyclo*hexylpropionic acid. The reaction is effected with an active nickel at a temperature of 170° to 185°. Four esters have been prepared, and also β-*cyclo*hexylpropionamide.—R. **Lépine** and M. **Boulud**: The secretion of the two kidneys compared. In the healthy dog one of the ureters generally furnishes less urine than the other; there are also differences in the composition of the urine.—Henri **Renan**: Results of the discussion of observations made by MM. Delporte and Viennet, to determine by wireless telegraphy the difference of longitude between the Royal Belgian Observatory and the Observatory of Paris. The observations extended from May 1 to August 2, 1912, and comprised twenty determinations by wireless telegraphy and nineteen by ordinary telegraphy. The mean error of a single observation was ±0·0245 sec. by wireless and ±0·0285 sec. by ordinary telegraphy.—J. **Clairin**: The invariants of the characteristics of partial differential equations of the second order with two independent variables.—Vasilesco **Karpen**: The flight of birds called hovering flight. A calculation showing that hovering flight is possible when the mean geometric acceleration of the wind reaches 30 cm. to 50 cm. per second.—J. de **Boissoudy**: The law of radiation of a black body and the quanta theory.—Albert **Turpain**: Extra-sensitive relays for wireless telegraphy. The relay dscribed has a sensibility of the order 0·01 microampere.—C. **Tissot**: The reciprocal influence of two neighbouring antennæ.—F. **Bodroux**: Some liquid mixtures particularly suitable for the observation of Christiansen's phenomenon. A suitable mixture is made by pouring 15 gr. of ethyl acetate and 10 gr. of water into 50 gr. of saturated sodium chloride solution.—E. **Rothé**: The reception of radio-telegrams by multiple antennæ with or without contact with the soil.—A. **Guyau**: An interferential oscillograph. The apparatus figured was designed to register photographically oscillations of the magnitude of those of a telephone membrane.—B. **Szilard**: A spiral electrometer.—Ch. **Fabry** and H. **Buisson**: The absorption of ultra-violet light by ozone, and the extremity of the solar spectrum. The authors' results, taken with those of Cornu on absorption by the atmosphere, are in accord with the hypothesis of the absorption of the ultra-violet rays by ozone in the atmosphere.—B. **Bianu**: The secondary radiation produced by the α rays.—Camille **Matignon**: Chemical equilibrium in the action of hydrochloric acid gas on zinc sulphate.—E. **Rengade** and N. **Costeanu**: The anhydrous monosulphides of the alkaline metals. The pure sulphides, Na_2S, K_2S, and Rb_2S, were obtained by allowing the vapour of sulphur to react upon the metal, with special precautions against the access of air. These sulphides are very easily oxidised; it is sufficient to touch one at a point with a hot glass rod for the mass to become incandescent and burn like tinder.—E. E. **Blaise**: The migration of chlorine in the chloroketones.—A. **Lassieur**: The catalytic hydrogenation of acetone. At temperatures between 200° and 300° C. hydrogen in presence of reduced nickel gives with acetone neither isopropyl alcohol nor pinacone, but methyl*iso*butylketone in large quantities, smaller amounts of valerone and other higher condensation products.—P. **Lebeau** and A. **Damiens**: The composition of coal gas. An application of the general method of analysing complex mixtures involving the use of very low temperatures recently described by the authors. The presence of ethane, propane, and butane was proved with certainty.—L. **Ravaz** and G. **Verge**: The germination of the winter spores of *Plasmopara viticola*.—L. **Blaringhem**: The phenomena of xenia in wheat.—C. L. **Gatin** and C. M. **Bret**: The varieties of *Elais guineensis*, of the Ivory Coast, and their parthenocarpic fruits.—Paul **Becquerel**: Vascular ontogeny of the plantule of the lupin and its consequences for certain theories of the classical anatomy.—Anna **Drzewina** and George **Bohn**: Anoxybiose and chemical polarity. An account of the effects of deprivation of oxygen on various species of invertebrates.—E. **Bataillon**: Demonstration of inoculation superposed on puncture in traumatic parthenogenesis.—Mlle. **Chevroton** and M. **Fauré-Fremiet**: A kinematographic study of the cytoplasmic phenomena of the division of the egg of Ascaris.—G. J. **Painvin**: The siphon of the Spirulæ.—H. **Vincent**: The action of polyvalent antityphoid vaccine in subjects in the incu-

bation stage of typhoid fever or infected in the course of immunisation. From experience gained in the typhoid epidemics cited it would appear that with this vaccine there is no negative phase, and there is no danger in vaccinating during epidemics.—MM. **Desgrez** and **Dorléans**: The influence of the amino group on the arterial pressure. A lowering of the blood pressure is produced by minimal doses of certain amino compounds, but an increase in the amount injected produces ultimately an increase in the arterial pressure.—J. **Houdas**: The presence of choline or allied bases in the saliva of the horse.—Em. **Bourquelot** and M. **Bridel**: The synthesis of the glucosides of alcohols with the aid of emulsin. β-Phenylethylglucoside and β-cinnamylglucoside.—Ph. **Négris**: The age of the cristallophyllian series of the Cyclades and the date of the foldings which have affected it.—F. **Dienert**: Study of the temperatures of subterranean water for public supply.—V. **Crémieu**: Seismographs giving directly the three components of an earthquake and slow variations from the vertical.

March 17.—M. P. Appell in the chair.—E. H. **Amagat**: Saturation curves and the law of corresponding states. The author concludes that the law of corresponding states is more rigorous than is usually admitted, and gives reasons for supposing that deviations from the law are probably due to experimental error.—A. **Müntz** and E. **Lainé**: The materials transported by the watercourses of the Alps and Pyrenees. The utilisation of mountain streams either for power or irrigation purposes requires an approximate knowledge of the amount of solid material brought down, as this material would tend to fill up more or less rapidly any storage reservoirs which might be constructed. A preliminary study has been made on eighteen rivers, and it has been found that the amounts of solid material brought down by alpine streams are so great that the construction of storage reservoirs will require very careful choice; the streams from the Pyrenees are much less troublesome in this respect.—M. **Gouy**: The theory of the gaseous photosphere.—D. **Eginitis**: The opacity of the sky and weakening of the solar radiation observed during the year 1912. The heliograph at Athens shows a progressive weakening in the solar radiation commencing April 7, 1912.—M. **Luizet** and J. **Guillaume**: Observation of the occultation of the Pleiades by the moon made on March 13, 1913, at the Observatory of Lyons. —Léon **Autonne**: Hypohermitian matrices.—Ch. **Muntz**: The solution of secular equations and integral equations.—Georges **Rémoundos**: Families of algebroid functions.—Farid Boulad **Bey**: The disjunction of the variables in equations representable by nomograms.—Th. De **Donder**: Hilbert's theorem of independence.—Carlo **Bourlet**: Apparatus for measuring the vibrations of solid bodies in motion. A description of an instrument for measuring the vibration of the wing of an aëroplane, based on the use of two manometric capsules.—Emile **Jouguet**: The propagation of deflagrations in gaseous mixtures.—Edouard **Guillaume**: The extension of the mechanical equations of Appell to the physics of continuous media. Application to the theory of electrons.—Kr. **Birkeland**: Hertzian oscillations produced by intermittent discharges starting from isolated spots of a kathode in a Crookes's tube. —Henri **Bénard**: The prismatic cleavage due to cellular vortices (starch, basalts, &c.).—Jean **Bielecki** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by acetone. In alcoholic solution and in the liquid state acetone possesses a single band in the ultra-violet; the absorption curve can be exactly represented by the formula of Ketteler, Helmholtz, Reiff, and Drude.—Mlle. E. **Feytis**: The magnetic properties of some solid hydrates of copper and chromium.—Daniel **Berthelot** and Henry **Gaudechon**: The decomposition of gaseous compounds by light. Hydrochloric acid is dissociated by the extreme ultra-violet, $\lambda < 0{\cdot}2\mu$. Hydrobromic acid is more readily decomposed, and, in presence of mercury, the decomposition after eight hours is complete. Water vapour is decomposed by rays $\lambda < 0{\cdot}2\mu$ to the extent of one-thousandth. Hydrogen sulphide and selenide are readily split up under the same conditions. —Mme. N. **Demassieux**: Study of the equilibrium between lead chloride and ammonium chloride in aqueous solution.—René **Dubrisay**: A new method of physico-chemical volumetric analysis.—A. **Wahl** and P. **Bagard**: Syntheses in the indigo series.—A. **Seyewetz**: The action of hydrochloric acid upon quinone sulphonic acid.—G. **Petit** and R. **Ancelin**: The influence of radio-activity upon germination. The experiments prove the stimulating influence of weak radio-activities on the plant cell.—L. **Moreau** and E. **Vinet**: The comparative effects of arsenic and lead in treatment of vines for the larvæ of Cochylis. Lead arsenate proved to be the most efficacious form of applying arsenic for the destruction of the larvæ of Cochylis.—D. **Keilin**: An intracellular fibrillary formation in the tunic of the salivary gland in the larva of Syrphinæ.—Raphael **Dubois**: The treatment of tuberculosis by marine micro-organisms. Cultures of a Micrococcus obtained from the pearl sac of *Pinna nobilis* or *P. squammata* were used to inoculate tuberculous guinea-pigs; eleven out of twelve survived.—Henri **Stassano**: The mode of action of the anti-coagulating substance of the plasma of propeptone.—Mlle. C. **Robert**: The antitoxin behaviour of calcium in the case of some nutritive salts in the culture of the pea and lupin in liquid media.—W. **Kopaczewski**: The dialysis of maltase.—M. **Deprat**: The Triassic strata in the region of the middle Black River (Tonkin).

CALCUTTA.

Asiatic Society of Bengal, February 5.—Dr. Malcolm **Burr**: Indian Dermaptera collected by Dr. A. D. Imms. A number of new localities for known species of earwigs are put on record and one new species is described.—Dr. W. A. K. **Christie**: The composition of the water of the Lake of Tiberias. The water of the Sea of Galilee is shown to differ widely from that of almost all lakes with an outlet, and to approximate more in composition to that accumulated in closed basins. The difference is due to the peculiar nature of the soluble constituents of the rocks of the neighbourhood, as shown by analyses of spring waters near the town of Tiberias.—Major J. **Stephenson**: Aquatic Oligochæta of the Lake of Tiberias. The collection obtained by Dr. Annandale from the edge of the Lake of Tiberias includes specimens of a number of species, representing several different families; but the majority are immature, and only two can be identified—a Helodrilus described as new, and *Criodrilus lacuum*, a common European species.

BOOKS RECEIVED.

Mysore Geological Department. Report of the Chief Inspector of Mines for the Year 1911–12, with Statistics for the Calendar Year 1911. Pp. 45+12 tables+81. (Bangalore: Government Press.) 2 rupees.

The Coleoptera of the British Islands. By Dr. W. W. Fowler and H. H. J. Donisthorpe. Vol vi. (Supplement.) Pp. xiii+351+3 plates. (London: Lovell Reeve and Co., Ltd.) 18s. net.

Handbuch der Morphologie der wirbellosen Tiere. Edited by A. Lang. Band 3, Lief. 1. Band 4, Lief. 2. (Jena: G. Fischer.) 5 marks each Lief.

Bericht über die Tätigkeit des Königlich Preussischen Meteorologischen Instituts im Jahre 1912. Pp. 53+172+3 plates. (Berlin: Behrend and Co.) 6 marks.

Bibliotheca Geographica. Band xvii. Jahrgang 1908. Pp. xvi+533. (Berlin: W. H. Kühl.)

Iowa Geological Survey. Vol. xxi. Annual Reports, 1910 and 1911, with Accompanying Papers Prepared in Cooperation with the U.S. Geological Survey. Pp. xvi+1214+xviii plates. (Des Moines: Iowa Geological Survey.)

Traité Complet d'Analyse chimique appliquée aux Essais Industriels. By Profs. J. Post and B. Neumann. Deux. Edition Française, Entièrement Refondue. By G. Chenu and M. Pellet. Tome Troisième. Second Fasc. Pp. 465–902+v. (Paris: A. Hermann et Fils.) 15 francs.

Traité de Chimie Minérale. By H. Erdmann. Translated by Prof. A. Corvisy. Tome Prèmier. Pp. iv+559. (Paris: A. Hermann et Fils.) 12 francs.

A New Philosophy: Henri Bergson. By E. Le Roy. Translated by V. Benson. Pp. x+235. (London: Williams and Norgate.) 5s. net.

Myths of the Modocs. By J. Curtin. Pp. xii+389. (London: Sampson Low and Co., Ltd.) 12s. 6d. net.

In the Lap of the Lammermoors. By W. M'Conachie. Pp. xii+315. (Edinburgh and London: W. Blackwood and Sons.) 5s. net.

The Belief in Immortality and the Worship of the Dead. By Prof. J. G. Frazer. Vol. i. Pp. xxi+495. (London: Macmillan and Co., Ltd.) 10s. net.

Das Miocän von Eggenburg. By Dr. F. X. Schaffer. (Abhandlungen der K.K. Geologischen Reichsanstalt. Band xxii. Heft 2.) Pp. 129–193+12 plates. (Vienna: k.k. Geologischen Reichsanstalt.) 16 kronen.

The Deciding Voice of the Monuments in Biblical Criticism. By Dr. M. G. Kyle. Pp. xviii+320. (London: S.P.C.K.) 4s. net.

Aus Süd-Brasilien. By Dr. W. Breitenbach. Pp. xvi+251. (Brackwede i.W.: Dr. W. Breitenbach.) 3 marks.

The Chemistry of Dyeing. By Dr. J. K. Wood. Pp. vii+80. (London: Gurney and Jackson.) 1s. 6d. net.

Volume and Surface Integrals Used in Physics. By J. G. Leathem. Second edition. Pp. iv+73. (Cambridge University Press.) 2s. 6d. net.

Machine Construction and Drawing. By A. E. Ingham. Pp. xii+143. (London: G. Routledge and Sons, Ltd.) 1s. 6d. net.

Vorträge über Deszendenztheorie gehalten an der Universität zu Freiburg im Breisgau. By Prof. A. Weissmann. Dritte Auflage. Erster Band und Zweiter Band. Pp. xiv+342+vii+354+3 plates. (Jena: G. Fischer.) 13 marks.

Die Palæobotanische Literatur. Edited by W. J. Longmans. Dritter Band. Die Erscheinungen der Jahre 1910 und 1911 und Nachträge für 1909. Pp. 569. (Jena: G. Fischer.) 26 marks.

DIARY OF SOCIETIES.

THURSDAY, MARCH 27.

CONCRETE INSTITUTE, at 7.30.—Props and Beams in Mines: Prof. S. M Dixon.

MONDAY, MARCH 31.

INSTITUTE OF ACTUARIES, at 5.—The Estimated Age Distribution of the Indian Population, as Recorded at the Census of 1911, and the Estimated Rates of Mortality, Deduced from a Comparison of the Census Returns for 1901 and 1911: T. G. Ackland.

TUESDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Recent Discoveries of Early Man: Dr. A. S. Woodward.

RÖNTGEN SOCIETY, at 8.15.—The Physiological Principles of Internal Radium Therapy: Prof. Saubermann, Berlin.—The Radiographic Episcope, a New Instrument for the Utilisation of the Single X-Ray Print: Dr. Cotton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Yield of Various Catchment-Areas in Scotland: W. C. Reid.—Measurement of the Flow of the River Derwent, Derbyshire: E. Sandeman.

WEDNESDAY, APRIL 2.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Moisture in some English, Colonial and Foreign Butters during 1910–1912, with a Note on the Mitchell-Walker Moisture Test: L. Gowing-Scopes.—Egyptian Butter and Semna: S. H. Trimen.—A Simple Test for Differentiating between Cocoa-Butter and "Green" Butters: C. Revis and E. Richards Bolton.—The Correct Way to Use Glycerine-Jelly in Mounting Microscopical Objects: L. W. Stansell.—A New Apparatus for Maintaining Constant Temperatures: F. H. Dupré and P. V. Dupré.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, APRIL 3.

ROYAL INSTITUTION, at 3.—The Bridge into Life: Dr. E. Frankland Armstrong.

LINNEAN SOCIETY, at 8.—Some Forms of *Alchemilla vulgaris*: C. E. Salmon.—Report on H.M.S. *Sealark*, Calcarea: Prof. A. Dendy.—*Embia major*, sp. nov., from the Himalayas: Prof. A. D. Imms.—A Free-swimming Nauplioid Stage in Palinuris: Dr. J. D. F. Gilchrist.—The Classification of the Order Symphyla: R. S. Bagnall.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Further Discussion*: Some Effects of Superheating and Feed-water Heating on Locomotive Working: F. H. Trevithick and P. J. Cowan.

FRIDAY, APRIL 4.

ROYAL INSTITUTION, at 9.—The Spectroscope in Organic Chemistry: Dr. J. J. Dobbie.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of the Nottingham District: B. Smith.

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THURSDAY, APRIL 3, 1913.

DESERT LAND FORMS.

Das Gesetz der Wüstenbildung in Gegenwart und Vorzeit. By Prof. Johannes Walther. Zweite, neubearbeitete Auflage. Pp. xv+342; illustrated. (Leipzig: Quelle and Meyer, 1912.) Price 12 marks.

DESERT regions have received much attention during recent years, and in this volume Prof. Walther presents a very instructive geographical study of the north-eastern part of Africa. This is something more than a new edition of that which he published under the same title in 1900, for the fourteen essays on different aspects of desert conditions which there appeared have been recast and rearranged under the headings of the character of the desert, erosion in the desert, and deposition in the desert, together with a fourth chapter in which the evidence for the identification of desert areas in the past history of the earth is assembled. A visit to Egypt and the north Sudan in 1911 provided the opportunity for extending and supplementing his earlier observations, and recent railway extensions enabled him in the time at his disposal to visit the oasis of Kharga, Khartum, and to cross the Red Sea hills between the Sudan plains and Suakin. The result is a very interesting and instructive work dealing primarily with a part of the north African desert, but introducing many examples from other arid regions of the world.

In treating of precipitation in the desert the author has, we think, in following Sickenberger, gone somewhat too far in saying that dew is entirely absent in the interior of the desert. The absolute humidity is usually not very low, and on cold-clear nights dew is not infrequently formed. Stress is rightly laid on the action of rainfall in areas which are fairly described in general terms as rainless, for such falls of rain are not at all uncommonly reported when a wide region is considered, though each fall may be extremely local in extent. The rock tombs on the west of the Nile at Thebes are quoted as providing evidence that the water from the Nile does not there percolate to any distance from its bed. Here the river flows in its alluvial flood plain for the most part. Grabham has shown that the varying levels of the Blue Nile are to be traced so far as 900 metres from its banks in the Sudan, and it appears from discharges which have been measured that a considerable loss from the river takes place, over and above that due to evaporation, in such long reaches as that near Dongola, where the river flows for long distances in the Nubian sandstone.

An especially interesting part of this book deals with the Sudan desert and the "half-desert," on the northern fringe of the monsoon rains, where the extreme aridity of the Nubian and Libyan deserts gives place to less inhospitable conditions and vegetation can develop to a limited extent. The Red Sea hills furnish most instructive instances of this, and of the erosion characteristic of such regions. Many interesting examples of erosion and of deposition are described, and are particularly well illustrated by characteristic and well-chosen photographs. Doubtless because the parts of the country which the author visited do not exhibit good examples of the process, there is not much reference to the filling of wide valleys and depressions with rock waste swept down from the higher levels which may be seen so finely represented further north than the Berber-Suakin route which was followed, in the valleys of the complex of crystalline ranges which form the western shore of the Red Sea. This greatly enlarged edition of a work already well known will be most acceptable to both geographers and geologists.

H. G. L.

THE PROPERTIES OF STEAM.

The New Steam Tables: together with their Derivation and Application. By Prof. C. A. M. Smith and A. G. Warren. With an introduction by Sir J. Alfred Ewing, K.C.B., F.R.S. Pp. xii+101. (London: Constable and Co., Ltd., 1913.) Price 4*s*. net.

PROF. CALLENDAR, in his Royal Society paper of 1900, suggested the use as the characteristic for steam of $v-b=R\theta/p-C\theta^{-n}=V-c$, say. This is suggested by the Joule-Thomson equation for gases, where $n=2$, and by Grindley's result for steam, in which $n=3{\cdot}8$. Only a man of Prof. Callendar's reputation could have received attention, for he gave rather fanciful reasons for taking $n=3{\cdot}5$, and for his values of the specific heats when p is very small. Again, it is probably quite untrue that c is a function of temperature only. Nevertheless, when steam tables are calculated by means of the above characteristic, the constants b, C, and n (and, indeed, R also) can be given such values as make the calculations agree with what Prof. Callendar regards as the best experimental results, and he recommended in 1900 that tables calculated from his formulæ should be substituted for the usual tables as given by Regnault and modified by Griffiths and others. The numbers of the new tables are consistent with each other, and this is a great advantage, because we generally need differences

of total heats, for example, rather than their absolute amounts.

Prof. Mollier, of Dresden, in 1906 published tables and sheets of curves calculated on Callendar's methods, and these were published by Sir J. A. Ewing in the third edition of his book on the steam engine in 1910. Prof. Smith and Mr. Warren have recalculated all the numbers (with slight divergences from Mollier's results), using values of the constants which seem to them best, and they reproduce Prof. Mollier's curves showing total heat on an entropy base. They give both Centigrade and Fahrenheit tables. If Prof. Callendar's methods are right there can be no doubt that Prof. Smith and Mr. Warren have done a great service to steam engineers. They nowhere state what is their unit of heat, but it is probably that which agrees with $J=1399$ or 1400. This will not agree with their figures for the total heat of water. It is also a pity that they do not give the actual experimental results on which their calculations are based; no doubt great weight is given to the Joly-Callendar value of L at 100° C., and to Callendar's specific heat as well as the Munich results.

Fair agreement of the steam tables with measured values of L, &c., is no proof that Prof. Callendar's method is legitimate, because good agreement may be effected even if we take c to be a constant, b being the volume of water, or, indeed, if we take steam to be a perfect gas. The only real test would be that the calculated specific heat for various temperatures and pressures should agree with measured values. This test cannot be applied until we have better experimental results. J. P.

PRACTICAL AGRICULTURAL CHEMISTRY.

Practical Agricultural Chemistry. By Prof. S. J. M. Auld and D. R. Edwardes-Ker. Pp. xxiv+243. (London: John Murray, 1913.) Price 5s. net.

UNTIL recently the teacher of agricultural subjects in this country suffered from the disadvantage (or advantage if one looks upon it in that light) that very few text-books were available to help him in his teaching. The result was that each man had to devise his own course and modify it as time went on and experience accumulated. There is a tendency at the present time for teachers to put their courses on record, and the plan has much to commend it.

The latest scheme thus printed is the laboratory course for students of agricultural chemistry used by Dr. Auld and Mr. Edwardes-Ker. It opens with a good section on plant-life which is distinctly fuller than usual, including experiments with certain plant constituents not commonly studied in other laboratories. The teacher will find material here that may be new to him and that he may advantageously embody in his own course. The section on soils presents few novel features; indeed, there are some directions in which marked improvements might be made. Above all things, it is necessary to be clear in dealing with the agricultural student. But we find that on p. 86 the "clay" in soil is estimated by a method which will bring out particles less than 0·002 mm. in diameter; on p. 90 by a method which brings out particles less than 0·01 mm. in diameter; while on p. 62 a scheme of classification of soils is given which supposes that "clay" is something altogether different from either. Yet there is no hint that the word is being used in three different senses. The precise definition of clay must be a matter of convention; it is much better for the young student to begin on the British convention and defer the detailed study of other conventions until he is more advanced in the subject.

We should like also to have seen some of the newer and improved methods of analysis brought in. The Neubauer method of examining soil extracts, and the titration method for determining phosphates, are much simpler and quicker than those given, while the perchlorate method of estimating potassium is at least as accurate as, and much cheaper and more convenient than, the costly and cumbersome platinum method. These, however, are essentially matters of detail, and as the authors have shown courage in introducing some new matter in their course, it may be hoped that they will have the further courage to test the newer methods that are now available and adopt them in their teaching. E. J. R.

SCIENTIFIC EGYPTOLOGY.

(1) *Service des Antiquités de l'Egypte. Catalogue Général des Antiquités Egyptiennes du Musée du Caire.* Nos. 61,051–61,100: The Royal Mummies. By G. Elliot Smith, F.R.S. Pp. vii+118+103 plates. (Le Caire: Imprimerie de l'Institut Français d'Archéologie Orientale, 1912.)

(2) *British School of Archaeology in Egypt* Studies Series. Vol. iii. The Formation of the Alphabet. By Dr. W. M. Flinders Petrie, F.R.S. Pp. iv+20+9 plates. (London: Macmillan and Co., Ltd., and Bernard Quaritch, 1912.) Price 5s. net.

(1) PROF. ELLIOT SMITH'S studies of mummification, the result of work carried out during the years he spent in Egypt,

have been brought to a fitting conclusion by the issue of this sumptuous catalogue of the royal mummies in the Cairo Museum. The work forms an exhaustive supplement, from the anatomical side, to Sir Gaston Maspero's monograph on the same subject. We meet with many old friends, but there is scarcely one about which the author has not something new to tell us. The earliest and perhaps the most tragic of these dead kings is the seventeenth dynasty Pharaoh Seqenen-Ra, whose agonised hands and battered face and skull bear witness to a violent death upon the field of battle. We note that Prof. Elliot Smith supports Maspero's view that the body was hastily mummified on the field, not transported to Thebes and subjected to partial decomposition, as Dr. Fouquet would have it. Another interesting mummy, or rather skeleton, is that of the heretic King Akhenaten, which was found five years ago by Mr. Theodore Davies in the tomb with Queen Tii's furniture, and was at first supposed to be that of the queen herself; we are glad to have the anatomical evidence as to age, &c., set forth in greater detail.

A subject of controversy on which these important researches throw new light concerns the influence which, it has been supposed, phallic ideas may have exerted on the technique of embalming in Egypt. The evidence against the theories appears conclusive, and cases quoted in support, such as the mummy of Rameses II., can be otherwise explained (see especially p. 61).

It is perhaps scarcely necessary to add the warning that the catalogue is for the scientific, not the general reader, who would find that much of it reads like a detailed report of a series of post mortem examinations; some of the photographs, too, though of the greatest possible value for the anthropologist, are naturally rather gruesome. But, as Prof. Elliot Smith justly remarks, since these valuable historical "documents" have come into our possession (mainly, it may be added, through the depredations of ancient Egyptian grave-plunderers), it is the duty of the man of science to read them as fully and as carefully as possible.

(2) In his latest work, "The Formation of the Alphabet," Prof. Flinders Petrie has given us fresh proof of his versatility. De Rougé's theory of the derivation of the Phœnician alphabet from the Egyptian hieratic writing of the twelfth dynasty is now generally discarded, and some ingenious theories have within recent years been propounded in its place. Prof. Delitzsch, of Berlin, for instance, has worked out for it an elaborate cuneiform ancestry; while Prof. Sayce has more recently suggested a purely Semitic source in Syria. Prof. Petrie holds that, instead of coming into existence as a small alphabet, enlarged and corrupted by later additions, its evolution was spread over a far greater area and longer period. It had its origin in a gradually formed signary, current far and wide throughout the ancient world, until it was slowly contracted and systematised. Thus the majority of the signs Prof. Petrie would trace back to a remote antiquity, no fewer than forty-four of his sixty elements beginning with pottery-marks in prehistoric Egypt. We have not space to discuss this very attractive theory in detail, but we would suggest to the professor in quite general terms the possibilities of fortuitous resemblance in cases of parallelism where the lines of cultural contact seem remote.

L. W. KING.

PHILOSOPHY AND ETHICS.

(1) *The Dynamic Foundation of Knowledge.* By Alexander Philip. Pp. xii+318. (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1913.) Price 6*s*. net.

(2) *High-School Ethics.* Book I. By J. Howard Moore. Pp. xiv+182. (London: G. Bell and Sons, Ltd., 1912.) Price 2*s*. 6*d*. net.

(3) *The Positive Evolution of Religion: Its Moral and Social Reaction.* By Frederic Harrison. Pp. xx+267. (London: William Heinemann, 1913.) Price 8*s*. 6*d*. net.

(4) *The Value and Destiny of the Individual.* The Gifford Lectures for 1912. Delivered in Edinburgh University. By Dr. B. Bosanquet. Pp. xxxii+331. (London: Macmillan and Co., Ltd., 1913.) Price 10*s*. net.

(1) ENERGY is the real thing, not matter. The keynote of philosophy is change. Sensation is not sensation of thing changing and of change; it is simple consciousness of change. Change implies power. All science is an interpretation of appearance in terms of power, which is the fundamental postulate. And our notion of power arises from our awareness of our own motor activity, which awareness is one of the first data of experience. Causation is a derivative postulate arising from this same awareness of self-activity; if we were passive photographic plates, we could have no conception of causality. We attribute potent efficacy to the things of sense which resist us, on the analogy of our own activity.

Philosophic systems come and go, as did theological discussions in their mediæval day; but the hope of the future is in the triumph of science. It offers the clue, viz., "to conceive of things in terms of their organic potency."

Reality is an ever-transmutable energy, and with this conception the contradiction between materialism and idealism is got rid of.

The book is well written, and contains much sound analysis of perception and the like, with much that is debatable but suggestive and stimulating.

(2) Lectures delivered by the author at the Crane Technical High School, Chicago, in his department as instructor in ethics; the volume is Book I. in a four-years' course which he is working out. It is not a text-book of "ethics" as we understand the word over here, but a series of moral lessons aiming at the improving of character rather than the imparting of knowledge concerning a science. They are admirably arranged, and deal with honesty, industry, earnestness, obedience, courtesy, self-control, sport and its cruelties, &c. Suitable anecdotes are introduced, and the style is breezy and interesting. It is to be hoped that many schools will use this pioneer volume as a manual. As Mr. Moore remarks, we have scarcely yet begun to educate the human young. When we become enlightened, we shall not consider when a new being comes into the world that the first and most important thing to do is to pounce upon him and teach him to read and write. The art of putting oneself in the place of others is a more important art, and the inculcation of this is a more important anxiety in child education than the art of reading and writing. It is noteworthy that the Illinois legislature passed a law three years ago requiring the teaching of morals and humanity in all the public schools of the State for thirty minutes every week. Illinois was the fourteenth State to adopt such a law.

(3) Mr. Harrison is always readable, and this collection of essays and discourses will serve as a useful popular compendium of Positivist doctrine. It suffers in places from a certain garrulity, and also the reader occasionally feels that the author is laboriously slaying the slain—as when he refutes "orthodox criticism," with its "scheme of personal salvation" and its "Almighty, Absolute, incomprehensible God." And, in view of the parade of "science" and "logic," he is rather dogmatic, though at the same time vague and general—*e.g.* "there can be little doubt that the average Orthodox Dissenter is far inferior in learning, culture, and breadth of view and nature to the average Churchman" (p. 171). These hasty personal judgments are injudicious, and, besides, such phrases as "average Orthodox Dissenter" and "average Churchman" are too vague to be of much use. It may even be doubted whether Mr. Harrison knows much about Dissent, for he speaks of some unnamed publication as the "authoritative organ of Orthodox Nonconformity" (p. 207). No such publication exists. Most of the greater dissenting sects have their own organ, but no one of these speaks for all. And, indeed, what *is* "Orthodox Nonconformity?" On the question of miracles, Mr. Harrison uses the antiquated phrase "suspension of the laws of nature," and talks of "violation" quite in the style of Hume. Surely after Mill and Huxley this language ought not to be used. With Mr. Harrison's agnosticism about a "Creator," and his emphasis on social effort and character-building, probably most scientific readers will heartily agree.

(4) After Mr. Harrison's relegation of metaphysics and absolutes to the lumber-room of outworn things comes Dr. Bosanquet's "truth which for us is now established, of the reality and perfection of the Absolute" (p. 260). No doubt they will read each other's books—or perhaps they will not—and will remain of the same opinion still. But there is a great difference between the two, in the eyes of what Mr. Harrison would probably call an "average reader." The one is a *littérateur*, the other is a thinker and philosopher. We have no space for an adequate review of Dr. Bosanquet's book (which embodies the Gifford lectures for 1911–1912), and must content ourselves with saying that the title well describes the contents, and that the author's view of time seems more satisfactory than that of Bergson, which he criticises.

OUR BOOKSHELF.

Plant Diseases. By Dr. Werner F. Bruck. Translated by Prof. J. R. Ainsworth-Davis. Pp. 152. (London: Blackie and Son, Ltd., 1912.) Price 2*s*. net.

It is difficult to see to what class of readers this book can be of use. The book claims to be "a concise introduction to the subject of plant diseases," and the field surveyed is very wide, fungous and animal parasites and diseases caused by adverse cultural or weather conditions being included. Except in a few instances, as, *e.g.* in the chapters on diseases of coniferous wood and on beet and mangold diseases, little is said on the changes produced by disease in the plant. In some cases the enumeration of the "pests" carries no information at all, *e.g.* in the list of "animal pests" of leguminous plants there is a bare list of nine names. Unfortunately much of the information is given in so vague a manner that the book cannot be recommended as a "primer" for the student, and it does not claim to give the detailed advice as to remedies necessary for the practical grower. One wonders what idea a student would carry away after reading the

following description (which is unaccompanied by any illustration):—"The *aecidium* is found below the cortex of a stem or the epidermis of a leaf"; and shares his bewilderment on reading, in the paragraph dealing with cultural methods, the sentence:—"Artificial solutions . . . ought to contain the substances present in the diseased specimens."

Although "mykoplasm" is mentioned, no reference is made to the discovery of "specialisation of parasitism" by Eriksson and others. This leads the author wrongly to assume that the hop and pea mildews spread from their numerous wild host-plants to the cultivated plants in question. The view expressed that *Nectria ditissima* is always the secondary and not the primary cause of apple-"canker" was disproved some time ago. By a slip *Fusicladium dendriticum* is stated to attack pears; and it may be pointed out that Alternaria is not an Oomycete, Hypochnus is not an Ascomycete, and that green vitriol is not copper sulphite.

The illustrations are bad, some extraordinarily so—*e.g.* those of corn-mildew, vine-mildew, apple-scab, and Orobanche. The last-named is certainly worthless; six botanists (all familiar with the plant), to whom it was shown by the reviewer, all failed to recognise the plant.

The best we can say is that the descriptions of the various fungi mentioned are clear, and the book is very free from misprints. E. S. S.

Technical School Organisation and Teaching. By C. Hamilton. With a preface by G. Udny Yule. Pp. xii+178. (London: George Routledge and Sons, Ltd., 1913.) Price 2*s.* 6*d.* net.

The great and rapid changes which have recently taken place in the organisation of technical education in evening schools have (says Mr. Yule) created a demand for a new series of text-books specially adapted to the new circumstances. The present volume is issued as a general introduction to the series. Its aim is to define the proper scope and function of evening school work, to discuss the organisation necessary to make that work effective, and to provide—especially for those who, without previous training or experience, become instructors in evening schools—a simple exposition of the chief principles of teaching. It is evident that the author has excellent qualifications for performing his task. In his introductory section he shows so clear a grasp of the problems of evening school work, so sane a view of its possibilities and of the part it should play in a national scheme of education, that he gains at once the confidence of his readers. The same lucidity, liberality, and practical good sense characterise the subsequent section on the arrangement of courses, the details of administration and the functions of examinations. The final sections show a refreshingly sound appreciation of the principles of method, and much skill in applying them to the special problems of the technical teacher. It is probable that these 120 pages will prove the most helpful and informative part of a thoroughly useful book. T. P. N.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

An Attempted Photochemical "Resolution" of Silver.

The recent correspondence between Prof. Schuster and Mr. Soddy in these columns suggests the placing upon record of a bold but unsuccessful attempt to split up the element silver which I made some years ago with one of my students. In these days, when tentative speculations are figuring so largely in the scientific world for positive knowledge, it may be necessary to point out that the research was prompted by no theoretical views concerning the compound nature of silver. But while there was no special *a priori* reason for suspecting the elemental character of that metal it was well known as a fact that its chloride, &c., on exposure to light only underwent a limited decomposition—*i.e.* that the photo-reduction ceased when a certain minute proportion of "photo-salt" had been formed. The consideration of this property of the silver halides suggested the interpretation (purely hypothetical!) that the "element" contained a constituent (say, α-silver) of which the chloride was sensitive to light, and another (say, β-silver) less sensitive or insensitive to light. From this it followed that if, after exposure and complete saturation with "photo-salt," the unchanged chloride could be separated from the photo-reduction product, the latter, on reconversion into chloride, should furnish a salt very highly sensitive as compared with the main portion of unchanged chloride.

For various reasons the research was never completed, chief among these reasons being the difficulty of effectively separating the minute trace of photo-reduction product from the large excess of unchanged chloride. Notwithstanding our failure, the experiment might be worth repeating under more favourable conditions since the relative sensitiveness to light of two specimens of silver chloride—the hypothetical α and β modifications could be easily detected and possibly measured. Even if a negative result is obtained it would seem worth the expenditure of time and trouble in order to set at rest the question raised by the hypothesis. Should the result be positive it is needless to point out that the discovery might have important practical bearings upon photographic processes. It may be worth mentioning that in the course of our experiments it was found that a boiling saturated solution of aniline hydrochloride was a good solvent for silver chloride. What is wanted, however, for the present purpose is some inorganic solvent which dissolves the unchanged silver chloride at ordinary temperatures more freely than the metallic chlorides (lithium, &c.) hitherto used for this purpose. Reagents like thiosulphates, cyanides, &c., which form salts with and freely dissolve silver chloride, appear to decompose too much of the "photo-salt" to be of use in such an inquiry. The bearing of the present discussion upon our abortive attempt to "resolve" silver is sufficiently obvious—is the darkening of a silver salt under the influence of light a case of "physical analysis"? R. Meldola.

Bournemouth, March 22.

Dana's Proof of Darwin's Theory of Coral Reefs.

In connection with Prof. Davis's paper on Dana's proof of Darwin's theory of coral reefs, which appeared in Nature on February 6, it is interesting to point out that land valleys which extend beneath the

sea are not always proofs of subsidence. Such valleys, like coral reefs, may owe their existence to different factors in different cases.

The harbours of this coast are the high parts of submarine fault valleys, and the portion bordered by land is often only a small part of the whole. Yet the evidence is very clear that the coast has risen regularly since the Red Sea was made, and that river erosion has had nothing to do with the formation of these steep-sided rifts. The coast of equatorial East Africa is essentially similar, though there the fault features are not so obvious, as they have been smoothed down somewhat by the heavy rainfall. Yet such harbours as Mombasa, Kilindini, Tanga, and Wasin are obviously homologous with those of Port Sudan, Suakin, and the desert harbours of the Red Sea.

Chwaka Bay, on the east coast of Zanzibar, is part of a depression which runs right across the island in a south-west direction, and forms long inlets where it reaches the sea on the other side.

The island of Pemba, a little north of Zanzibar, is dissected in a wonderful way on its west side by long fiords running far into the land, and ending in mangrove creeks, perfect slaver- and pirate-hiding places. The land is comparatively high and of great fertility, so that a coasting voyage among the fiords is one of great pleasure and interest.

Surely these are typical drowned valleys? Not at all; the island, like Zanzibar, was elevated in late Tertiary times, the fossils of its coral cliffs are Pleistocene or recent, and both islands have remained at or near their present level while their reefs were carved out. In places on the east coast of Zanzibar the reef is up to three miles wide, and is something between a fringing and a barrier formation. Yet it was all formed by abrasion of elevated coral land.

Along the edge of the deep water, in a line at right angles to the Pemba fiords, is a regular but broken line of reefs and islands, a typical barrier. Where the islands have not been worn away by the sea they are formed entirely of elevated coral, and the reefs have been formed by abrasion of land. When this process is complete, there will be a typical barrier reef, should the islands continue stationary at the level to which they were originally elevated.

The two islands, Zanzibar and Pemba, were originally regular oval cups of coral (or perhaps saucers rather, as in Pemba coral limestone is seen at lowest tide level a long way up Chaki Chaki Bay), and were connected with the mainland. These were filled with the sand and pebbles which now form most of the hills. After elevation they were cut off from the mainland by marine erosion, possibly (in the case of Pemba at least) also by a comparatively deep fault. Other faults on this side cracked the saucers, and irregularity was further induced by marine abrasion, in some places made excessive by powerful silt-bearing currents, in others neutralised by the protection afforded by growing coral and algæ. As along the deep water conditions more uniformly favour the growth of protecting organisms, the edges of the saucers retain their regularity, while within the mass of sand and the limestone on which it lies is subject to rapid degradation. The fiords are extending into the land among the mangrove swamps at their heads. The roots of the mangroves penetrate the crevices of the coral and cause shallow accumulations of mud, both factors for the disintegration and solution of coral limestone. I take the extremely complicated outline of the south end of Pemba Island to be an example of the barachois described by Prof. Gardiner in the results of the Percy Sladen Trust expedition to the western Indian Ocean.

In the Red Sea the heads of the harbours are being filled in with blown sand and flood-borne alluvium; but in Pemba there are no delta-like formations; the marine currents are far too powerful to allow of them, even if the streams were big enough to convey any quantity of alluvium.

In the Red Sea and equatorial East Africa we thus have, on stationary or rising coasts :- (1) Submarine valleys which are scarcely altered from the original fault rifts; (2) those of similar origin somewhat disguised by the effects of tidal currents and fresh-water streams.

The above have little if any continuation into the land, but in Pemba are found :- (3) Long fiords simulating drowned valleys, but of the same origin as (1) and (2); (4) barrier reefs formed by abrasion alone, in Zanzibar and Pemba.

In the Red Sea are (5) barriers which are features of the sides of a rift valley merely coated with coral.

(6) The barriers of the equatorial coast may be of the same origin as those of the Red Sea, but, if Zanzibar Island be reckoned a part of this barrier, removal of the intervening land has been at least the cause of the final separation, as proved by the fauna of the island. Probably they are comparable to the barrier of the west side of Pemba in structure and origin, due to the faulting and erosion of the heterogeneous material of coral deposits.

My statements here are dogmatic for want of space, but details are given in my papers in Proc. Camb. Phil. Soc., 1902, and Journ. Linn. Soc., vol. xxxi., 1907 and 1911.

My being in a distant and isolated village, which is, however, a few yards from coral reefs, is my excuse for the delay in your receipt of this contribution to the discussion. CYRIL CROSSLAND.

Dongonab, Red Sea, February 24.

Elliptical Lunar Halos.

ON the morning of January 26, 1908, while observing with the Keeler reflector of this observatory, I noticed a curious lunar halo, which I described as follows in the notes made at the time:-

"At 4.25 a.m. (Eastern standard time) I saw an elliptical halo close to and concentric with the moon. Its major axis was vertical, and was about 7° long, the lunar diameter being used to make this estimate. The horizontal axis was a little less than half the vertical, or about 3°. The halo lasted only about one minute, but was unmistakable, being well defined (except near the bottom) on both its inner and outer edges. It reappeared less distinctly at 4.31 a.m., lasting only a few seconds. I watched the moon until 4.50 a.m., but saw no third appearance. The halo was white in colour. There was a light east wind blowing at the time, and there was a little haze in the sky. The temperature was 28° F., and had been very constant all night. The moon was at last quarter."

At my request the other observers here have watched for such a halo, and on December 1, 1908, both Prof. Jordan and Dr. Baker witnessed a much longer appearance of it. Prof. Jordan's notes read as follows:—

"An elliptical lunar halo was visible here on the evening of December 1, 1908. The night began with a very clear sky, but about eight o'clock a slight haze became visible in the neighbourhood of the moon. This soon began to take definite form, and the halo developed. It remained visible until about 9 p.m., when it gradually disappeared and the sky soon became cloudy. The halo varied greatly in brightness because of the varying amount of haze in the atmosphere: very

definite and bright when the amount was large, and occasionally disappearing in part or even completely as the atmosphere cleared. Sometimes the whole halo became uniformly faint, while at other times portions of the circumference disappeared. The major axis was vertical, the moon being about on the meridian. The axes were estimated to be about 7° and 4° respectively, but no careful measures were made. The colour, if any, was very slight. The moon was at first quarter."

None of my astronomical friends to whom I have described these elliptical halos has ever seen one. They must be rare phenomena, and well worth recording. FRANK SCHLESINGER.

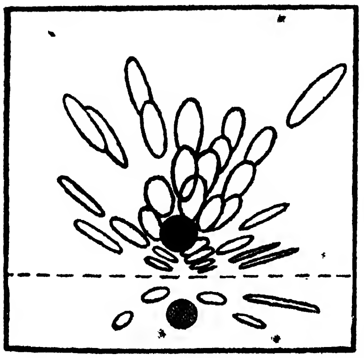
Allegheny Observatory, February 24.

The halo appears to be that known as "Hall's halo," but the diameters given are rather less than those observed by Hall. The phenomenon is mentioned in Pernter's "Meteorologische Optik" (p. 262), and an explanation is suggested by him on p. 381 of that work. [ED. NATURE.]

The Reflection of X-Rays.

IN continuation of the experiments of Mr. W. L. Bragg (NATURE, December 12, 1912, p. 410), I have investigated the reflection of X-rays by mica. Mr. Bragg finds one reflected beam, while Messrs. Hupka and Steinhaus (NATURE, March 6, 1913, p. 10) find two beams. Using a parallel pencil and an angle of incidence of 70°, I find no difficulty in photographing five beams emerging from the "incident" side of the mica, of which that obeying the ordinary laws of reflection is the most obvious.

From the "transmitted" side of the mica sheet there are certainly no fewer than thirty distinct beams apart from the intense primary beam which has passed through the crystal (0·33 mm. thick) without much absorption. The plane of the mica sheet was perpendicular to that of the photographic plate. In the reproduction given below, the intense black spot is produced by the transmitted primary beam, while beneath it is seen another circular patch due to the ordinary reflected beam.



The greatest photographic intensity occurs in those transmitted beams which have suffered the least deviation, the ordinary reflected pencil being feeble in comparison with some of them.

It will be evident that the transmitted pattern is analogous to that obtained by Messrs. Laue, Friedrich, and Knipping (NATURE, November 14, 1912, p. 306), using a pencil of X-rays falling normally on a crystal of zincblende. Repeating my experiments, using a normal pencil, a transmitted pattern is obtained similar to theirs.

Besides giving rise to numerous pencils in definite directions, the mica sheet exhibits the ordinary incident and emergent scattering. It is well known that this effect is small in the plane of the radiator. This is borne out in all the negatives which exhibit general fogging, except along a line which represents the line of intersection of the photographic plate by a plane containing the mica sheet. This line is represented in the diagram by the broken line. Similar results are obtained using rock salt and galena.

Since the photograph described above is unsuitable for reproduction by a half-tone block, I have been obliged here to substitute a diagrammatic copy for it.

H. B. KEENE.

Physics Department, University of Birmingham, March 15.

The Presence of Protozoa in Soils.

UP to the present, so far as I am aware, the only method of demonstrating the presence of Protozoa in soils has been by cultures. This method, of course, leaves untouched the really important question as to what Protozoa are leading a trophic existence at any given time in a soil sample, since many of the forms found later on in cultures may be derived from cysts. In these circumstances I thought it might be of interest to direct attention to a method by which the presence of Protozoa in the trophic stage in the soils can be readily demonstrated, even though this method from a quantitative point of view probably gives low results.

A small quantity of the soil to be investigated is mixed, as soon as it is collected, with about an equal volume of picric acid. The mixture is then placed in a wide dish and carefully stirred, so that the organisms on the surface films between the soil particles are free. If the mixture is then allowed to stand for a time it will be found that most of the bacteria, diatoms and Protozoa that were present come up to the surface film. The coverslips, cut according to the method which I have previously described, can then be floated on the film, and then placed in tubes containing corrosive. These cover-slips can then be handled as though they were ordinary smears. The best method of staining seems to be to stain for some time in strong acid haemalum, followed by eosin. I have tried mixing the soil in the first instance with other fixatives in the place of picric acid, but have not obtained such good results. By this method perfectly clean preparations, showing large numbers of amœba and flagellates, have been obtained from a six weeks old bed, which had been used for growing seedling cauliflowers. These have been used to compare the active fauna of such a soil with the fauna derived from the same soil in cultures.

As might be expected, it has been found that the prevalence of any given Protozoon in the cultures is not an indication of its prevalence in the trophic stage in the soil, though by varying the methods of culture it has been found possible to cultivate all the Protozoa that have been found by the above method leading a trophic life in this soil at the date of fixation.

C. H. MARTIN.

The Hill, Abergavenny, March 19.

Jelly-fish of the Norquane River.

THE discovery of a jelly-fish in the northern watershed of the Limpopo will be of some interest to zoologists.

During the new year holidays, while making zoological collections in the Bembezi district (thirty miles north-east of Bulawayo), I noticed some jelly-fishes in a pool of the Norquane River, a tributary of the fourth degree of the Limpopo.

With the scanty literature at my disposal, it is not possible at present to identify or determine it as a new species, but judging by the figures in Lankester's "Treatise on Zoology" and in the "Cambridge Natural History," and also by Mr. Moore's statement ("The Tanganyika Problem") that *Limnocnida tanganyikae* varies in size from that of a shilling to

a two-shilling piece, and is as flat as those coins, these jelly-fishes are not referable to that species.

In life, they are almost hemispherical and slightly flattened on top; the largest do not measure more than 16 mm. in their widest part, and the smallest measure about 6 mm.

The Norquane is a narrow stream with a sandy bed cut into a succession of pools by granite bars. In all the pools over a distance of a mile, hundreds of the jelly-fishes were to be seen. The first specimen was found in a pool about 20 ft. by 30 ft. and 7 ft. deep, late in the afternoon, and a careful search did not at first reveal any more. Shortly after my having a bathe in the same pool, numerous specimens came to the surface, and subsequent observation showed that the creatures swim near the surface in the earlier part of the day, and retire to the deeper water during the hotter hours, from which they were disturbed by the bathing. Their stinging powers, however feeble, probably render the jelly-fishes unpalatable to the fishes in the pool (chiefly *Barbus 3-maculatus* and Tilapia sp.), which left them severely alone.

I hope to be able soon to obtain Günther's paper in the *Q.J.M.S.* on *Limnocnida tanganyikae*, when it will be possible to decide whether or not this is a new and the fifth known species of fresh-water medusa. I should add that a careful examination of several pools during three days failed to reveal any signs of a hydrosome stage.

G. ARNOLD.

The Rhodesia Museum, Bulawayo, February 21.

An Experiment for Showing Lines of Force in an Electrostatic Field.

THE general directions of the lines of force between charged conductors can be shown by a method which, though extremely simple, shows as much as the elegant but somewhat elaborate apparatus described by Mr. R. F. D'Arcy (NATURE, March 20) would seem capable of.

It is simply to allow a scrap of cotton-wool to fall between the knobs of a Wimshurst machine, or among any conductors connected with them. As soon as the bit of fluff touches one of the conductors it moves off rapidly along a line of force. If the other conductor is oppositely charged the fluff will strike it, and again be repelled, usually in a slightly different direction, thus traversing a different line of force, and so on.

The scrap of charged fluff moves so rapidly under the electric forces that, owing to the persistence of vision, the shape of its path is very evident, and, owing to its lightness and the relatively great resistance offered by the air to its motion, its path approximates very closely indeed to the line of force.

BERNARD M. NEVILLE.

William Ellis School, London, N.W.

Snail-cavities in Stones.

REFERRING to Mr. E. W. Swanton's letter in NATURE of March 20, may I point out that the Agglestone rock is a sandstone composed of quartz grains bound together by a ferruginous cement.

I believe the excavations of *Helix aspersa* on rock surfaces are produced by chemical action, and that the secretion only acts as a solvent where salts of lime are present. This assumption seems reasonable on the supposition that the snails require lime for the construction of their shells.

Sandstones, unless calcareous, would have to be attacked mechanically by snails for cavities to be formed. Is there any evidence to prove that such cavities have been produced in sandstones?

C. CARUS-WILSON.

COMPLETION OF THE DISCOVERY OF THE GREENLAND COASTS.[1]

THE last part of the coast of Greenland to remain undiscovered is the north-eastern tract between Germania Land and the area reached by Peary on his famous journey across the northern ice-sheet to Independence Fiord. This gap has been filled by the Danish expedition under Erichsen, which discovered that instead of the coast continuing in a fairly direct course from Germania Land in 77° N. to Peary Land in 82½° N., Greenland projects in a long peninsula for 5° to the east. The work of the supporting parties of this expedition made some interesting additions to the glacial geology of Greenland, which have been published in Koch and Wegener's memoir on the glacial observations. Erichsen's expedition achieved its object, but he and his two companions, Hagen and the Eskimo Brönlund, perished during the return journey. Brönlund was able to reach nearest home. His body and diary, with a map by Lieut. Hagen, were found by a search-party under Captain Koch. These papers announced the success of the expedition and its tragic end. The journals of Erichsen and Hagen were not recovered, and an expedition to search for them was dispatched under Captain Ejnar Mikkelsen in 1909. This expedition was successful in recovering some messages left by Erichsen in his depôts, but it also nearly perished on the return journey.

The expedition sailed in a small sloop, the *Alabama*, but its plans were disorganised at the start. It called at the Faröe Islands to receive its dogs. But of the fifty dogs which had been bought in Greenland, twenty-three had died on the voyage to the Faröes, and the rest were so diseased that they had to be shot. The *Alabama*, therefore, had to go to the Eskimo settlements in south-eastern Greenland to buy dogs, and was thus seriously delayed. The expedition reached its base, Shannon Island (lat. 75° 10′ N.), on August 27, and a party in the autumn sledged up the eastern coast as far as Lambert's Land (79°), where they found Brönlund's grave. After wintering on Shannon Island, Captain Mikkelsen and Lieutenant Iversen marched across the inland ice to the head of Denmarks Fiord, which had been discovered by Erichsen; they searched its coasts, found the site of Erichsen's camps, and recovered the messages left in them. Mikkelsen had intended to return to the Eskimo settlements on the western coast through the strait which, according to Peary, extends across northern Greenland; but this plan had to be abandoned when it was found from one of Erichsen's notes that "the Peary channel does not exist, Navy Cliff being connected by land with Heilprin Land." The author has commented severely on this mistake, but, considering the sufferings it caused him, his annoyance is intelligible.

[1] "Lost in the Arctic." Being the Story of the *Alabama* Expedition, 1909–12. By Ejnar Mikkelsen. Pp. xviii+400+plates. (London: W. Heinemann, 1913.) Price 18s. net.

The two explorers therefore started back from the mouth of Independence Fiord around the north-eastern peninsula of Greenland in order to

FIG. 1.—The glacier front. From “Lost in the Arctic.”

reach their base on Shannon Island, 7° to the south. They were delayed by the rotten condition of the thawing ice and the difficulty of crossing the numerous water-leads. They were compelled to wait until the return of colder weather improved the conditions of travel. During most of the return march the two travellers were on very short rations, and the conditions of the season were so unfavourable that there was very little fresh food to be obtained. The seals were so thin that they sank when shot, so seal-meat was not procurable. Both men were attacked by scurvy, from which they were once cured by killing a few birds. Without dog transport their position would have been hopeless; but by eating the last of their dogs they managed to reach some of the depôts that had been laid for Erichsen. When at length they arrived at Shannon Island, they found that the *Alabama* had been wrecked and their companions had left. They had to spend two further winters at their base before their rescue in the spring of 1912.

The main geographical result of the expedition was the discovery from Erichsen's notes that the Peary canal is not a continuous strait but two fiords, so that the northern end of Greenland is not a separate island. Captain Mikkelsen's own work has added to the topography of this most inaccessible part of the Greenland coast. His book is most graphically written; it tells the story of perhaps the most adventurous arctic journey from which the explorers returned to narrate their experiences. The two men succeeded in their errand owing to the same sound judgment and geographical insight which enable them to survive the terrible hardships of the return journey.

FIG. 2.—Iversen's sledge. From “Lost in the Arctic.”

The book does not give any of the scientific results of the expedition, which will no doubt prove to be valuable from an observer of such wide arctic experience as Captain Mikkelsen. The book is illustrated by many instructive photographs, which are arranged haphazard, and by a map which is the most inconveniently placed that we remember to have seen.

CORONÆ, GLORIES, AND HEILIGENSCHEIN.

DURING May and June, 1912, several correspondents described a number of optical phenomena, principally solar haloes, which they had observed just before the commencement of the remarkable haze which covered the sky in the northern hemisphere during the summer months of last year, and a short article dealing with the simpler haloes and mock suns appeared in NATURE (vol. lxxxix., p. 377). Recently attention has been directed to certain less generally known and less majestic phenomena (possibly also less ominous), which are described as (1) coronæ, (2) glories, Ulloa's rings, anthelia, or Brocken spectres; (3) haloes, or more strictly Heiligenschein or dew glories, and a note on these may supplement the earlier article.

Coronæ are luminous rings around the sun or moon, usually, although not necessarily, smaller than the smallest halo properly so called, which has a radius of 22°. The order of their colours is opposite to that of haloes, red being outside and blue inside for each ring. Inside the first ring is the aureole of a peculiar pale-tinted blue near the luminary, with brownish-red next to it. Sometimes the aureole alone is visible.

Coronæ are produced by diffraction either by small drops of water or possibly by ice-needles, although Dr. Simpson, from observations in the Antarctic with a party led by Captain Scott in September, 1911, and from theoretical considerations, concluded that coronæ there were not produced by ice-crystals, but by super-cooled drops of water, and drew the very important deduction that "liquid" water exists in the atmosphere at temperatures far below the ordinary freezing point. The more uniform the size of the drops in the cloud producing a corona, the more brilliant is the phenomenon. The angular radius θ of a coronal ring is proportional to the wave-length λ of the colour of the ring and inversely proportional to r, the radius of the drops, but a small correction is necessary on account of the fact that the sun or moon is not a point-source of light, but has a definite diameter. Observed radii θ must be diminished by 16′ before they are used in the formula $\sin\theta = c\lambda/r$, where c is roughly 0·8, 1·3, 1·9 for the first, second, and third rings. The intensity of the light in the rings is of the order of 1/100 of the intensity of the direct light from the source. The diameter of the drops in clouds producing coronæ varies from about 0·01 to 0·04 millimetres.

Glories are luminous rings seen around the head of the shadow of the observer upon a cloud. They are specially frequent upon mountains, hence the name Brocken-spectre. Antonio de Ulloa, the Spanish captain who took the French scientific expedition to Peru in 1735 and explored the Andes with Bouguer and Condamine, shares with Bouguer the honour of having first given a precise description of the phenomenon which is sometimes associated with his name. Scoresby, the arctic explorer, observed glories frequently in polar regions, with clouds rising from the sea, by climbing the mast of his ship. On one occasion he saw as many as four coloured rings.

Accounts of glories occur on almost every page of the logbook kept by the observers on Ben Nevis, and on one occasion, November 23, 1884, they saw as many as five together, varying in radius from less than 2° to more than 10°. According to Pernter, glories are coronæ produced by reflected light. They are consequently much less intense than direct coronæ, and are usually seen by sunlight. Out of nearly 200 glories described by the Ben Nevis observers, only three were seen by moonlight. Mascart, however, attributes glories to diffraction of the incident light in the same way as if it were travelling in the opposite direction, and against this explanation the objections which Miss A. Everett quotes (January 23) from Prof. Richarz would not hold.

Haloes or glories around the shadow of the head thrown on dewy grass in early morning or evening have been called "Heiligenschein" to distinguish them from haloes of the ordinary type. The "Heiligenschein" is a real phenomenon which can be photographed, and it extends some distance from the edge of the shadow. It is not to be confused with the apparent brightness around the shadow thrown on a flat surface, which is a purely subjective phenomenon. This latter may explain the brightness along the shadow of an overhead tram-wire mentioned by Mr. Merrick in a letter. The Heiligenschein is most clearly seen in meadows where the grass is more or less uniform in length and orientation, and is covered with small drops of dew. The height of the sun should be such that the length of the shadow is 40 ft. or more. The phenomenon is attributed to the light reflected from the spherical dew-drops both directly and after two refractions and one or more internal reflections. These effects give a maximum intensity in the direction of the incident light, the intensity falling off continuously without alternation of colour. It is, therefore, quite distinct from haloes, coronæ, and glories.

The halo on ruffled water described by Prof. Worthington in NATURE of February 13 (p. 647) appears to be akin to Heiligenschein, although the condition of slight turbidity which he postulates suggests that the turbid constituents may act in a similar way to fog particles.

In addition to the letters already published in NATURE, several others have been received. Mr. T. S. Patterson, of Glasgow University, refers to Benvenuto Cellini and the consolation which

golfers may gain by contemplating the Heiligenschein when they are searching in the lengthening shadows for a missing ball; Mr. G. A. Shakespeare, of Birmingham University, also refers to Cellini and to the subjective effect at the edge of a shadow, and to the peculiar effectiveness of the leaves of the white pink in producing Heiligenschein; Mr. G. Merrick, of Newcastle, states that he has observed Heiligenschein around the head of a person 4 ft. from him—an unusual occurrence—and along the shadow of an overhead tram-wire; Mr. G. M. Davies, of Croydon, describes an observation of a "glory" on Snowdon at 3 p.m. in September, 1905; Mr. Howard Fox, of Falmouth, relates an experience in Cornwall forty years ago as he was driving along the road, when he saw a glory on a low fog, followed later by a white "fog-bow." A note has also been received of a "halo" of about 15° diameter seen on the surface of Lake Suwa in Central Japan by Viscount Tanaka. In this case the phenomenon might be attributed to diffraction by minute water-drops condensed in the air just above the surface of the lake, but such an explanation would fail if, as stated, the colour-bands were radial. The phenomenon is discussed in an article (in Japanese) in the Journal of the Meteorological Society of Japan (December, 1912).

"H. V. G." refers to the radial appearance of dust on the surface of a mirror owing to the particles of dust and their images presenting to the eye the appearance of short straight lines.

E. G.

THE OIL-SHALES OF THE LOTHIANS.[1]

THE memoir on the oil-shales of the Lothians published by the Geological Survey of Scotland in 1906 contained so much valuable information that the first edition was exhausted in 1911, and the second edition, brought thoroughly to date, has now been issued, and forms a most welcome and valuable addition to our knowledge at a time when the Scotch shale-oil industry is exciting so much interest as a possible asset to the Empire in the supply of fuel oil.

Nearly the whole of the industry is confined to a belt of land some six miles in breadth, which stretches from near Dalmeny on the Firth of Forth in a southward direction to the moorlands around Cobbinshaw and Tarbrax. The first portion of the memoir is devoted to the geology of this shale-oil field, the survey of which was commenced by Sir Archibald Geikie in 1857, carried on by Mr. H. M. Cadell and the late Mr. James S. Grant Wilson, and is now brought up to date by Mr. R. G. Carruthers. The second part deals with the methods of working the oil-shales, and has been entrusted to Mr. W. Caldwell, whose wide experience as mining engineer to the Pumpherston district makes this section of special value: whilst in the third and concluding portion of the work Mr. D. R. Steuart describes the treatment of the shale from the time it leaves the mine until its products are ready for marketing.

The history of the shale-oil industry is one that always appeals strongly to the imagination as an illustration of how every obstacle can be surmounted by dogged perseverance and determination, and the fact that to-day the industry still holds its own after a forty years' war with the powerful oil combines of America and the East is one of which every British subject should be proud.

The late Lord Playfair often declared that he was the founder of the Scotch shale-oil industry, and certainly it was he who in 1847 directed the attention of James Young to a trickle of oil from the shale in the Riddings Colliery, near Alfreton. On distilling this oil Young produced an excellent lubricant, the demand for which soon exhausted the supply, and imbued with the idea that the oil had been formed by a low temperature distillation of the coal, he experimented with many varieties and found that boghead cannel from West Lothian was best suited for his purpose. In 1850 the Bathgate works were started by Messrs. Young, Meldrum and Binny, and for twelve years the boghead coal, or Torbanehill mineral as it was often called, yielded an ample supply of oil for illuminating and lubricating purposes, as much as 120 gallons of crude oil per ton being obtained from it.

The supply of this material becoming exhausted, in 1862 shale was used in its place, but yielded only a third of the volume of crude oil; in spite of this, the expiry of Young's patent in 1864 led to a rapid expansion of the shale-oil industry, which, however, received a severe check soon after. In 1859 Drake had discovered how to obtain natural oil in enormous volumes by boring in Pennsylvania, and by 1864 it began to be imported into England in large quantities, with the result that lamp oil, which during the existence of Young's patent had varied from 3*s*. 6*d*. to 2*s*. 6*d*. per gallon, fell to 1*s*. 5*d*. to 1*s*., whilst, to make matters worse, the Americans began to import into this country lubricating oils and paraffin wax, which before had been practically a monopoly with the Scotch distillers.

In 1873 the Russian fields also entered into the competition, and for a time it appeared as if the Scotch industry must succumb, but by amalgamating the small works with the larger, by organisation, the adoption of labour-saving appliances, and the introduction of every form of economy the crisis was survived, and the manufacture of sulphate of ammonia from the nitrogen in the shale helped the Scotch oil industry to hold its own in spite of the overwhelming odds.

In 1871 there were fifty-one works in Scotland, producing 25,000,000 gallons of crude oil per year, but in 1894 these had been reduced to thirteen oil companies, and at the present time there are only seven, but the production of crude oil has risen to 70,000,000 gallons.

[1] Memoirs of the Geological Survey, Scotland. The Oil-shales of the Lothians. Part I., The Geology of the Oil-shale Fields. By R. G. Carruthers, based on the work of H. M. Cadell and J. S. Grant Wilson. Part II., Methods of Working the Oil-shales By W. Caldwell. Part III., The Chemistry of the Oil-shales. By D. R. Steuart. Second Edition. Edinburgh: Morrison and Gibb, Ltd., 1912.) Price 2*s*. 6*d*.

At the present time two of the most important questions in the public mind are how the enormous demand for motor spirit that has of late developed is to be met, and the imperial question of securing fuel oil for our Navy in the case of war interfering with our over-sea supply, and it will be of interest to see how far the Scotch shale-oil industry can help in these directions.

The rapid increase in the number of motor-driven vehicles during the past few years has doubled the consumption of motor spirit since 1908, the amount used in this country during 1912 reaching the enormous total of 80,000,000 gallons, whilst the quantity of motor spirit produced by the Scotch distilleries would be about 600,000 gallons, or 0·75 per cent. of the total used, an amount which is practically negligible. Considerations of safety on board limit the proportion of the oil that can be used for naval fuel, and the total amount of oil of satisfactory character that is at present produced by the Scotch industry and would be available for such purposes would be only about 50,000 tons, which again is only a small fraction of the quantity needed, but the proximity of the shale fields to the new naval base at Rosyth encourages the hope that the Government will secure and accumulate a sufficient quantity of liquid fuel from this source to safeguard the supply in case of war.

In the portion of the memoir dealing with the chemistry of the oil-shales, Mr. Steuart has collected a mass of most interesting facts, not only with regard to the shale oil, but also bearing upon the probable formation of the shale beds, and the whole work is so full of interesting and suggestive points that no one interested in oil or allied subjects should fail to read it.

THE ANALYSIS OF COLOURING MATTERS.

THE Eighth International Congress of Applied Chemistry, which was held in New York in September last, adopted a report submitted by a subcommittee of the Commission Internationale d'Analyses, to which was referred the question of the possibility of unifying the methods of analysis of organic colouring matters.

The subcommittee was international and very representative in character, the British members being Prof. E. Knecht and Mr. C. Rawson of Manchester. The report, which was presented by the president, Dr. F. Reverdin (Switzerland), in a short historical summary of the subject, states that the first systematic scheme was that of O. N. Witt, who, in 1886, suggested a differentiation of the various types of colouring matters by their behaviour on reduction. This reaction, developed and improved by other workers, notably by A. G. Green, is now the basis of the usual method of identification. So early as 1874 Kopp proposed the use of the characteristic absorption spectra of dyes as a means of identifying them, and this method has been greatly improved and extended by Formanek, Grandmougin and others. The photo-spectroscopic method proposed in 1911 by Porai-Koschitz and Auschkap has not yet been much used.

The individual reports from the various national representatives, which constitute the bulk of the report, deal mainly with the analysis of colouring matters for Customs purposes.

The subcommittee finally reports that the unification of the methods employed in the analysis of colouring matters is not possible in the present state of the industry, and would not be of much practical use. It considers, however, that an international agreement would be advantageous in certain cases, such as that of the organic dyestuffs used in colouring foodstuffs, and also where the assessment of Customs duties is required.

The subcommittee has therefore been reappointed by the International Commission of Analysis and instructed "to investigate special cases in which the unification of the methods of analysis of organic dyestuffs offers some interest from the international standpoint."

The committee requests that anyone interested in the subject will communicate information or suggestions to the president (Dr. F. Reverdin, Geneva) or to the British representatives above named.

NOTES.

THE death of Lord Wolseley on March 25, in his eightieth year, should not pass unrecorded in a scientific journal, for he was distinguished among great soldiers by his devotion to scientific methods. His capacity for organisation, recognition of the value of knowledge, and regard for accuracy and completeness are attributes not always associated with military careers. His "Soldier's Pocket-Book," now pubshed by the War Office, is rich in details relating to medical, engineering, and other aspects of field operations which depend upon science for their success. He held that it was essential for every officer to have a good knowledge of his science in order to be able to apply that knowledge usefully in the field, when cut adrift, perhaps, from civilisation. We share with the rest of the nation the feeling of regret that a life which has brought so much credit to the British Army is now ended. Lord Wolseley's body was laid to rest in St. Paul's Cathedral on Monday, with impressive funeral ceremonies, but his works will long remain a monument to his memory.

THE construction of trustworthy and enduring flying machines has been much encouraged by various large money prizes given by *The Daily Mail*. When in 1906 our enterprising contemporary offered a prize of 10,000*l*. for a flight by aëroplane from London to Manchester in twenty-four hours, with not more than two stoppages, there was little anticipation that it would be won, yet M. Paulhan accomplished the feat in 1910. A further prize of 10,000*l*. for a circuit of Great Britain, covering a distance of 1000 miles in one week, with eleven landing-places, or control stations, at each of which a descent had to be made, was won by M. Beaumont in 1911. Now *The Daily Mail* offers a third prize of 10,000*l*. for a flight by

waterplane either way across the Atlantic in seventy-two continuous hours, without any limitation as to nationality of pilot or place of construction of the machine. A prize of 5000*l.* will also be awarded to the pilot who takes a waterplane of entirely British invention and construction round England, Scotland, and Wales, and within one mile of Kingston Harbour, in seventy-two continuous hours. The waterplane is a very promising type of aircraft, and we have little doubt that both prizes will eventually be won. From a national point of view it is important that encouragement should be given to the design and performance of a machine which can start from a water surface or come to rest upon it. The prescribed tests are severe, but not more so than are necessary to decide the efficiency of the waterplane both as regards flexibility and range of action. The new prizes offered by *The Daily Mail* will encourage aviation engineers and pilots to produce a machine by which the two courses will be successfully traversed, and thus bring us nearer that conquest of the air which will be the distinguishing characteristic of the present century.

IN America it is quite common for waters to have an unpleasant fishy, oily, or "geranium" taste, due to the excessive growth of certain algæ. Some species grow best during the colder months of the year, others attain their maximum development during the summer. The water supplies of the United Kingdom are usually free from these unwelcome visitations, but many instances have occurred of temporary unpleasantness arising from this cause. London has been singularly fortunate in this respect, yet there can be no doubt that the present commendable policy of storing river water antecedent to filtration increases the risk of algal troubles arising in the future. At Easter time the consumers of West Middlesex water became unpleasantly aware that the supply had a peculiar aromatic taste and smell, which, with apologies to horticulturists, may be likened to geraniums. The water is derived from the Thames, and is stored for a long period in the Staines reservoirs. After re-storage at Barn Elms and Barnes, it is filtered and pumped into supply from the Hammersmith side of the river. First the complaints arose along the line of direct supply from the pressure mains, later the Hampstead area became affected owing to the back-flow of tainted water which meanwhile had accumulated in the service reservoirs. Dr. A. C. Houston informs us that the growth was largely composed of Tabellaria, together with some Asterionella, and the taste developed chiefly during the process of filtration. Remedial measures were at once carried out, and all the implicated filter beds were closed, with immediately satisfactory results. The water, although unpalatable, was at no time unsafe for drinking purposes. The best way of killing algæ is to treat the affected water with copper sulphate (dose, from 1 to 10 lb. per million gallons), and Dr. Houston has found that the most satisfactory way of removing the taste from a water which has become already tainted is to use potassium permanganate (dose, about 2·5 to 5 lb. per million gallons).

THE International Geographical Congress was opened at Rome on March 27 by King Victor Emmanuel. We hope to give an account of the proceedings in an early issue.

WE are informed that the Royal Botanic Gardens Department, Ceylon, has been replaced by a Department of Agriculture, and that communications should in future be addressed to the Director of Agriculture, Peradeniya, Ceylon. The work of the Royal Botanic Gardens will be continued under the new department.

ON the nomination of the Gassiot Committee of the Royal Society, the Meteorological Committee has appointed Mr. L. F. Richardson, assistant lecturer in physics at the Municipal School of Technology, Manchester, to be superintendent of the Geophysical Observatory at Eskdalemuir, in succession to Mr. G. W. Walker, resigned.

THE Vienna correspondent of *The Times* announces that Prof. J. Hampel, the eminent Hungarian archæologist, died at Budapest on March 25. As one of the directors of the National Museum and the leading authority on the pre-Christian archæology of Hungary, Prof. Hampel was held in high esteem in his own country and in archæological circles throughout Europe.

WE are informed that the optical and mechanical engineering works of Ernst Leitz, of Wetzlar, which recently completed their 150,000th compound microscope, have presented this instrument to his Excellency Prof. Ehrlich, of Frankfort-on-Main, thus doing honour to a genius of scientific discovery. It may be remembered that the 100,000th Leitz microscope was presented to the late Prof. Robert Koch, the famous bacteriologist, who was director of the Imperial Institute for Infectious Diseases, Berlin.

ARRANGEMENTS are being made for the starting, in July next, of an expedition to Crocker Land, under the auspices of the American Museum of Natural History and the American Geographical Society. One of its special features will be a seismological investigation. The seismograph, which will be in charge of Ensign Fitzhugh Green, of the U.S. Navy, is of the Weichert horizontal type, and carries a stationary mass of 80 kilos. It will be sheltered in a hut of special design, so arranged as to preclude violent changes of temperature. The instrument will be furnished by Georgetown University, Washington, and an attempt will be made to carry on daily communication, by means of wireless messages, between the explorers and the seismographers of the University.

THE inauguration of a new President at Washington has necessarily been followed by many changes in important Federal offices. Among them is the appointment of Dr. D. F. Houston to be Minister of Agriculture, succeeding Mr. J. Wilson, who has held that post continuously for sixteen years, under four administrations. Dr. Houston was president of the Agricultural and Mechanical College of Texas from 1902 to 1905, and of the University of Texas from 1905 to 1908. Since that date he has been

Chancellor of the Washington University at St. Louis. He is now in his forty-eighth year. A change has also been made in the assistant secretaryship of the Department of Agriculture, where Mr. W. M. Hays is succeeded by Mr. B. T. Galloway, who has been since 1900 chief of the Bureau of Plant Industry. Mr. Galloway had previously spent twelve years as chief of the Division of Vegetable Pathology and Physiology. Before entering the Government service he was an assistant in the horticultural department of the University of Missouri, of which he was a graduate in agricultural science. He is the author of a large number of works on botany and horticulture.

An official guide, who commenced his duties on April 1, has been appointed to conduct parties of visitors round the collections in the Royal Botanic Gardens, Kew. Two tours will be made daily, except on Sundays and public holidays; one of about an hour and a half, starting at 11.30 each morning, and one of about an hour at 3 each afternoon, except during June, July, and August, when the afternoon walk will start at 5. Morning parties will be limited to six persons, and will visit the plant houses and museums; in the afternoon twenty persons will be conducted round parts of the outdoor collections. In the morning each member of the party will be charged 2*s.* 6*d.*, and in the afternoon the charge per person will be 1*s.* Visitors wishing to join a party should attend at the stone portico of Cambridge Cottage, Kew Green, shortly before the time of starting. The new arrangement will meet the needs of those visitors who, in addition to their desire to enjoy the beauty of the gardens, wish to understand something of the scientific value and botanical significance of the unique exhibits at Kew.

Disastrous floods have followed the severe windstorms in the United States on March 23. The areas chiefly affected are the middle western States. The storms seem to have started on the eastern side of the Rockies, and to have rapidly developed energy occasioning the heaviest rains in the Ohio and Mississipi valleys. Immense tracts of country have been submerged, and many large towns have become flooded. Much of the ground is below the flood level of the rivers, and in parts the embankments have given way, whilst many tributary rivers have overflowed their banks. Dayton, Indianapolis, Columbus, and numerous other smaller towns have suffered immensely during the last week of March and much loss of life has occurred. Hundreds of houses have been washed away, and immense suffering has been caused. At Louisville the river is said to have passed the level of the great flood of 1907. Fortunately the immense loss of life given in the earlier reports was somewhat exaggerated, and later estimates at the end of March give the total casualties in the stricken area as 500. The rivers are said to be still rising in many places, and the full result of the disaster will depend largely upon the weather for the next week or two.

We have received the first two monthly issues of *The O.S. Review, the Journal of the Organisation Society.* This society (which has offices at 15–16 Buckingham Street, Adelphi) aims at applying objective methods of analysis and presentation to the data upon which all social legislation and administrative activity upon the large scale must be based. This aim necessarily implies that the society must itself "be outside politics, parties, and every kind of movement" in order to become "a centre of authority and reference," the activities of which will tend to bridge the present "gap between legislation and fact," and to minimise the distorting effects of political bias. The two numbers of the review offer illustrations of the proposed methods of research and of the application of the society's cardinal principle that "society is an extension of the individual." The society has a branch—"the Andrological Institute"—the special function of which is to collect and analyse measurements of bodily organs and physical and mental functions. As an *exposé* of its aims and methods it has published an elaborately illustrated pamphlet which deals in particular with measurements of mental "perseveration."

The general meeting of the American Philosophical Society will be held in Philadelphia on April 17–19, when the president, Dr. W. W. Keen, will take the chair. A very varied programme will be provided, and it is possible here to refer to a few only of the numerous papers. These include:—"Interpretations of Brain Weight," Prof. H. H. Donaldson; "Heredity and Selection," Prof. W. E. Castle, of Harvard University; "The Nature of Sex and the Method of its Determination," Prof. C. E. McClung, of Pennsylvania University; "The Control of Typhoid Fever by Vaccination," Prof. M. P. Ravenel, University of Wisconsin; "New Spectroscopic Evidence for the Solvate Theory of Solution," Prof. H. C. Jones, Johns Hopkins University; "The Magnetic Field of the Sun," Dr. G. E. Hale, director of the Solar Observatory at Mount Wilson, Cal.; and "Progress of New Lunar Tables," Prof. E. W. Brown, Yale University. On the evening of April 18, Prof. G. G. MacCurdy, Yale University, will give an illustrated lecture on "The Antiquity of Man in the Light of Recent Discoveries." On April 19 a symposium on wireless telegraphy has been arranged, in which the following physicists will take part:—Dr. L. W. Austin, head of the U.S. Naval Radio-Telegraph Laboratory; Prof. G. W. Pierce, Harvard University; Prof. M. I. Pupin, Columbia University, N.Y.; and Prof. A. G. Webster, Clark University, Worcester.

The problem of the cooperation of museums with education is being seriously considered in America. In No. 3, vol. iii. of *The Museum Journal* we have a description of the means by which the museum is being made accessible and interesting to school children. The arrangement of the exhibits is geographical, and special attention is naturally paid to the large collections illustrating the life of the American Indian, his arts and industries. A native and his wife, of the Chilkat tribe, are employed on the museum staff, and, dressed in their national costume, take an active part in class-work, moving among the children, explaining the exhibits, and answering questions regarding them. This arrangement is described to be

successful in promoting among the children an intelligent interest in the collections.

AMERICAN ethnologists generally accept the view that the American native race did not originate in that continent, but that it is the result of a comparatively recent, post-glacial, immigration, and that the Indian, closely related to the yellow-brown peoples of eastern Asia and Polynesia, represents, in the main, a gradual overflow from north-eastern Siberia. To supply evidence in support of these conclusions, Dr. A. Hrdlicka, of the U.S. National Museum, has recently made an extensive tour in Siberia and Mongolia, the results of which are summarised in No. 16, vol. lx., of the Smithsonian Miscellaneous Collections. His inquiries tend to establish the origin of the American Indian from eastern Asia. Dr. Hrdlicka points out the immense archæological remains, in the shape of burial mounds, or Kourgans, which still await excavation in north-eastern Asia. When the scientific exploration of this region is systematically undertaken, much important material for the examination of American ethnological problems will certainly be provided.

IN *Man* for March Mr. J. Edge-Partington, under the title of "A Note on Certain Obsolete Utensils in England," gives an account of a collection of old-world appliances, mostly connected with cooking and brewing, which have passed out of use. Mr. Digby-Wyatt, in his house, Weston-Corbett, Hants, has furnished an old room with a very interesting series of such utensils. Mr. Edge-Partington's collection includes all sorts of curious specimens—fire-dogs, pestles and mortars, bread shovels, gophering-irons, meat-jacks, pot-hooks, and "lazy backs," brewing appliances, and many other things of the same kind, which throw much light upon the domestic life and manners of our ancestors. It is surely time that the suggestion for the establishment of a museum of folk culture, to contain specimens of this kind, which are rapidly disappearing and soon can never again be brought together, was seriously considered.

THE campaign against tuberculosis has advanced a further stage. A general order of the Local Government Board, extending the principle of compulsory notification to all forms of human tuberculosis came into force on February 1. A further order of the Board of Agriculture and Fisheries makes the notification compulsory of tuberculosis of the udder, indurated udder, and other chronic diseases of the udder, and of tuberculosis or apparent tuberculosis of any bovine animal. This order is to come in force on May 1. Animals found to be suffering from tuberculosis are to be slaughtered, and compensation will be given on a scale depending on the extent of the tuberculous disease.

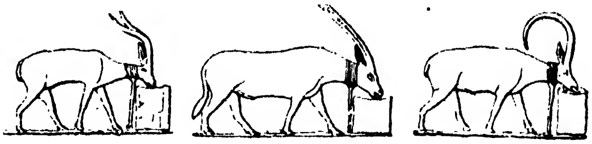
AN appreciative memoir, accompanied by an excellent portrait, of Dr. E. A. Wilson, the naturalist to Capt. Scott's expedition, appears in the March number of *British Birds*, Dr. W. S. Bruce being the author; while the story of Wilson's life and work is sympathetically told by Dr. Shipley in the April number of *The Cornhill Magazine*.

A VALUABLE report, by Mr. J. Johnstone, on some mussel beds in Lancashire and North Wales as regards their liability to sewage contamination has been issued by the Lancashire and Western Sea Fisheries District, under the direction of Prof. Herdman, F.R.S. The beds in several districts are found to be polluted. Mr. Johnstone, in his introduction, makes some interesting remarks on methods of examination and on "standards" from the statistical point of view.

WE have to acknowledge the receipt of the fourth annual report—for the year ending March 31, 1912—of the Superintendent of Dominion Parks, Canada. It is there stated that the predictions made a few years ago "in regard to the mountain parks have been more than realised, and their development has already exceeded the most sanguine expectations. . . . Judging from past development and present indications, it is a difficult matter to estimate the limit of the usefulness of these mountain parks as unique pleasure and health resorts, not only for the Dominion, but for visitors and tourists from almost every part of the world." The report is profusely illustrated with photographs of striking scenery.

ADDITIONAL evidence of the affinity of the Tertiary fauna of eastern Europe and western Asia to that of North America is afforded by Mr. E. Kiernick's description of a new species of Titanotherium from the neighbourhood of Prague, in *Bull. Ac. Cracovie* for December, 1912. The Titanotheres are essentially an American group of perissodactyle ungulates, but in 1876 a specimen from Transsylvania was referred to the family under the new generic term Brachydiastematherium, while in 1892 Prof. Toula referred a jaw from Rumelia to the American genus Menodus, as *M. rumelicus*. Some doubt has been thrown on the reference of the former to the Titanotheriidæ, but Mr. Kiernick considers that it is a member of that family, albeit of the aberrant group Palæosyopinæ. The Prague fossil, which consists of part of a lower jaw, with the last molar, is assigned to the typical genus, under the name of *Titanotherium bohemicum*.

FROM an interesting article by Dr. Claude Gaillard, of the Museum of Lyons, published in the *Revue d'Ethnographie et Sociologie*, Paris, 1912, Nos. 11 and 12, it appears that the ancient Egyptians were in the habit of keeping several of the wild ruminants



A B C

Dorcas gazelle (A), white oryx (B), and Nubian ibex (C) from the tomb of Mera at Sakkara. (After Gaillard.)

of north-eastern Africa in a state of semi-domestication for the purposes of the table. Among the species thus kept were the dorcas gazelle, the addax, the white oryx, and the Nubian ibex, representations of all of which are shown in a bas-relief in the tomb of Mera at Sakkara, dating from the sixth dynasty, in asso-

ciation with those of domesticated cattle and goats. That they were kept in a captive condition is indicated by the circumstance that in each case they are shown feeding out of a trough and haltered, and also by the prefix or the word *ran*, apparently indicating domestication, to their names.

THE January number of *The Quarterly Journal of Microscopical Science* (vol. lviii., part 3) again bears witness to the large amount of experimental investigation which is being carried on by biologists. The eggs and larvæ of sea-urchins afford material for no fewer than three papers by different writers. There is an interesting paper by the late G. H. Grosvenor, whose untimely death has inflicted a great loss upon zoological science, and Geoffrey Smith, on the life-cycle of the small fresh-water Crustacean, *Moina rectirostris*. These authors point out that, according to Weismann, sexual forms should be produced in every parthenogenetic generation independently of external conditions, but they actually find that by isolating the parthenogenetic females at birth until the production of the brood at a temperature of 25° to 30° C., the production of sexual forms is entirely suppressed. They conclude that the influence of isolation and of a high temperature on the suppression of the sexual forms may be ascribed either to the comparative absence of excretory matter or else to highly favourable nutritive conditions. Another memoir of special interest to students of animal bionomics is on stolon formation in the remarkable polychæte worm, Trypanosyllis, by F. A. Potts, which forms an important contribution to our knowledge of the very curious processes of asexual multiplication by budding that take place in this group. We must, however, enter a protest against the use of the term "stolon" for the reproductive individuals which arise by budding in such cases.

ALTHOUGH much work has been done in recent years on the bacteriological conditions in soils in temperate zones, there has been hitherto a scarcity of data relating to soils in tropical and subtropical countries. On this account a report of studies on Indian soils, by Mr. C. M. Hutchinson (Memoirs of the Department of Agriculture in India, Bacteriological Series, vol. i., No. 1), forms a welcome addition to the subject. Investigations have been undertaken with the view of testing the methods already in general use for the purpose of ascertaining their value under Indian conditions. The phenomena associated with the partial sterilisation of the soil, the occurrence of bacteriotoxins, and the rapidity of biochemical changes, such as ammonification, nitrification, and nitrogen fixation, have been subjected to a critical study. The view that the decomposition of cellulose is due chiefly to the activities of anaërobic organisms is perhaps given too much prominence in the discussion of the utilisation of organic residues.

MR. J. VAN BAREN, of the Landwirtschaftliche Hochschule in Wageningen, Holland, publishes in the *Compte rendu* of the eleventh International Geological Congress a paper on red stony loam as a product of interglacial weathering. He notes the occurrence of this material as isolated sheets in eastern Holland, overlain by Boulder Clay or Boulder Sand, and points out that the fragments of iron-bearing silicates in the red loam show, by their rusted condition, signs of atmospheric weathering. The small pebbles are also strikingly attacked, in distinction from those obtained from the sandy residue of the overlying Boulder Clay. The author urges that the Red Boulder Loam is decidedly older than the second series of glacial deposits above it, and that its weathered condition indicates exposure during an interglacial epoch. The analyses given do not support his contention that the products of weathering are lateritic. Comparisons are made with similar materials in north Germany, north Italy, the east coast of England, and the United States, and the desirability of chemical investigations of these is pointed out. In the discussion on the paper Mr. van Jentsch urged that a red colour in such deposits does not always imply a weathered condition.

WE have received a separate copy of the address given by Prof. J. von Kowalski to the Swiss Naturforschenden Gesellschaft at the Altdorf meeting last year. It deals with the relations between radiation and energy, and, after giving an account of the work of Wien and others, sketches the quanten theory as advanced by Planck, and stated with great clearness by Einstein in 1905. After showing how fertile the theory has been in suggesting new lines of research in both theory and experiment, the author emphasises the fact that at the present time the point of view provided by the theory is already known to be too restricted. Having served the true function of a theory—to indicate the line of advance—it must soon be replaced by some more general conception which will make clear to us those relations between matter and energy of which the quanten theory has given us a misty glimpse.

OBSERVATIONS on the seiches of Japanese lakes were begun in 1901, on the suggestion of Prof. Nagaoka. Four years later, the seiches of the nearly circular lake Toya, in the island of Hokkaido, were found by Prof. Honda to have a period of 9·29 minutes. In 1911, Mr. N. Mori found the period to be 4·5 minutes, and suggested that the mean depth of the lake had increased by about fifty metres during the interval of seven years. Mr. K. Sano shows, however, that the two periods may be the result of different modes of vibration if account be taken of the existence of the circular island in the middle of the lake (Journ. Meteor. Soc. of Japan, January). He finds that the period of the seiches would be 10·25 minutes if the water oscillate with a straight nodal line through the common centre of the lake and island; and 3·9 minutes if there were a circular nodal line midway between the boundaries of the island and lake.

A PAPER on measurement of the flow of the River Derwent, Derbyshire, by Mr. E. Sandeman, read before the Institution of Civil Engineers on April 1, contains some interesting particulars. The flow of the river has been measured since 1905, when a weir was built by the Derwent Valley Water Board, to

ascertain the yield from an area of about fifty square miles of the northern portion of the watershed. The area in question varies in elevation from 500 to 2060 ft. Rain-gauges to the number of forty-six were fixed on this area, being approximately 1 to each 700 acres. In the last thirteen years the recorded rainfall has averaged 46·34 in. The lowest rainfall of any of the gauges was 34 in., and the highest 61 in. The flows over the measuring weir are recorded on a rotating drum driven by clockwork with cam attachment. The highest flood on the drainage area occurred before the building of the weir. It was calculated to have reached a flow of 486 cu. ft. per sec. per 1000 acres from an area of 9321 acres. The minimum flow recorded was 0·29 cu. ft. per sec. per 1000 acres. Records of evaporation from a water surface 6 ft. square showed a variation from 10·25 in. in 1907 to 19·62 in. in the year 1911. The general result of the measurement of the rainfall and the yield of the river showed that the quantity of water collectable was—on the average of the seven years under consideration—equal to 75·2 per cent. of the rainfall.

MESSRS. LONGMANS, GREEN AND CO. have in preparation a series of monographs on physics, which will to some extent follow the lines of their monographs on biochemistry and on inorganic and physical chemistry. The editors of the physical series will be Sir J. J. Thomson, O.M., F.R.S., and Dr. F. Horton, of the Cavendish Laboratory, Cambridge. The first volume in the series will be "Rays of Positive Electricity," by Sir J. J. Thomson.

MESSRS. HENRY SOTHERAN AND CO., 140 Strand, and 43 Piccadilly, London, have issued part viii., forming part iii. of the Supplement, of their "Bibliotheca Chemico-Mathematica." The catalogue not only contains an unusually complete collection of works on the exact sciences, including many old works of rarity and interest, but also on such kindred subjects as ballooning, horology, and meteorology. The net prices of the volumes are given in every case.

THE classified list of Smithsonian publications, available for distribution on January 1 last, has been published by the Smithsonian Institution of Washington. The institution is able to supply papers only as an aid to the researches or studies in which applicants are especially interested. The papers included in this list are distributed gratis, except as otherwise indicated. Of the serial publications of the institution, the volumes of "Contributions to Knowledge" and of "Miscellaneous Collections" are distributed only to public libraries and to learned societies.

MESSRS. J. AND A. CHURCHILL announce the following works for early publication:—"Liquid Air, Oxygen, and Nitrogen," by G. Claude, translated from the French by H. E. P. Cottrell; "The Examination of Waters and Water Supplies" (second edition), by Dr. J. C. Thresh; "A Laboratory Text-book of Chemistry," part i., by V. S. Bryant; vol. vii. of the new edition of "Allen's Commercial Organic Analysis," rewritten, under the editorship of W. A. Davis and S. S. Sadtler.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR APRIL:—

April	6.	5h. 33m.	Sun eclipsed, invisible at Greenwich.
	,,	12h. 0m.	Jupiter at quadrature to the Sun.
	8.	5h. 10m.	Venus in conjunction with the Moon (Venus 4° 1′ N.).
	9.	22h. 41m.	Saturn in conjunction with the Moon (Saturn 6° 22′ S.).
	20–22.		Maximum of Lyrid meteors.
	24.	14h. 0m.	Venus in inferior conjunction with the Sun.
	,,	17h. 0m.	Mercury at greatest elongation W. of the Sun.
	26.	2h. 19m.	Jupiter in conjunction with the Moon (Jupiter 5° 9′ N.).
	27.	16h. 24m.	Uranus in conjunction with the Moon (Uranus 3° 52′ N.).
	,,	21h. 0m.	Uranus at quadrature to the Sun.

THE RADIAL VELOCITY OF α PERSEI.—Hnatek having recently published the conclusion that the radial velocity of α Persei varies in a period of 4·1 days, it appeared desirable to Mr. J. H. Pitman (Lick Observatory Bulletin 224) to undertake a comprehensive treatment of the subject based on all available observations. In addition to the many results already published by various authorities, the chief being the long series by Goos and Hnatek, the author has employed ten hitherto unpublished determinations. Six of these made during October, 1912, give a mean velocity of $-2{\cdot}49 \pm 0{\cdot}42$ km. per second. The discussion leads to the conclusion that the radial velocity of α Persei must be either constant or only minutely variable in a period still undetermined.

THE SMITHSONIAN ASTROPHYSICAL OBSERVATORY.—The report on the operations of the Smithsonian Astrophysical Observatory for the year ending June 30, 1912, has been received. The director, Mr. C. G. Abbot, is to be congratulated on the success at last attending his persistent efforts to obtain a grant from Congress. This enabled simultaneous spectrobolometric determinations of the solar constant of radiation to be made at Bassour, Algeria, by the director, and at Mount Wilson by Assistant Aldrich, on twenty-nine days during August–November, 1911. The observations have not yet been completely reduced, but so far as the first half of September the values obtained at Bassour agree with those previously determined at Washington and Mount Whitney in indicating a local condition at Mount Wilson tending to make the results too small by about 2 per cent.

Further, it appears that high solar constant values obtained at Bassour coincide with high values at Mount Wilson, and *vice versâ*. This relation is exhibited in two diagrams; in the first the curves obtained by plotting the successive values at the two stations show a rough parallelism; in the second the simultaneous values are plotted, and instead of grouping round a centre they are seen to be strung out along a line. It is further stated that a solar variation of 4 per cent. was indicated at both stations. The importance of setting at rest the question of the variability of this fundamental factor in meteorology is thoroughly realised by the energetic director, who returned to Bassour last May to extend his former observations. Mr. Fowle had already commenced work at Mount Wilson in April. It is confidently anticipated that the combined results will be decisive. The solar constant work has received help from valuable results obtained by Mr. Fowle in continuation

of the research on the absorption of radiation by water vapour. To him is due a spectrobolometric method of determining (within 1 or 2 per cent.) the total quantity of water vapour between the observer and the sun. This method should supersede the approximations based on psychrometric observations at different levels.

This observatory undertakes the fitting up, standardisation, and packing of the copies of the silver disc pyrheliometers supplied at cost price by the Smithsonian Institution. During the past year ten of these instruments were sent out, chiefly to Governmental meteorological stations.

THE SPECTROSCOPIC BINARY BD -1° 943.—The star δ Orionis was found by Hartmann in 1904, to be a spectroscopic binary, but the K-line did not take part in the regular displacements of the other lines. The hypothesis he has put forward to explain this apparent anomaly is that the K-line was due to the absorption of a calcium cloud which lay between stars of this class and the solar system. In the *Astronomische Nachrichten*, No. 4633, Zaccheus Daniel informs us that a star the position of which is 5h. 28·9m. -1° 13′, and was announced by Adams to be a spectroscopic binary, has a similar peculiarity to the one mentioned above. Its Harvard magnitude is 5·37, and its spectrum B2. Measurements of five, on the thirteen spectrograms secured at the Alleghany Observatory, of the best hydrogen and helium lines indicate a range in velocity of more than 200 km., a period of 3·05 days satisfying these velocities. Measurements of the K-line on eleven plates give velocities ranging from +5 to +25 km., the mean being +17 km. This value is nearly the same as that deduced by Hartmann from his measures of δ Orionis, which star is less than a degree from the binary under the above heading.

VARIABLE STAR CHARTS.—In the *Annales* of the Astronomical Observatory of Moscow, published under the direction of Prof. W. Ceraski (supplement to vol v., second series), Prof. Ceraski publishes a third series of thirty photographic charts of variable stars discovered by Madame L. Ceraski on the clichés of the observatory. The size of each chart represents eighty minutes of arc, and the charts are oriented after the Bonner Durchmusterung. The position of the variable is the centre of the plate, and is indicated by a small cross. Twelve of the variables represented are of the Algol type. The charts serve the very useful purpose of identification of the variables recorded, and are well reproduced.

EDUCATIONAL ORGANISATION IN AUSTRALIA.

TWO events which are certain to have great influence in the future development of education in Australia have recently taken place in New South Wales. One concerns the secondary schools of New South Wales, the other the University of Sydney. But in both cases their effects are sure to extend beyond the boundaries of the State to which they apply.

The first is that the Department of Public Instruction has introduced into New South Wales the system of intermediate and leaving certificates, as begun and carried out with success by the Scotch Education Department. An examination for the intermediate certificate has just taken place. Between 1500 and 2000 candidates presented themselves; but on this occasion the examination was only open to pupils of the State schools. At the close of next year the first complete leaving certificate examination will be held, and probably about 1000 candidates will come forward. That examination, and those in later years, will be open not only to the pupils of the State schools, but also to those of private secondary schools which have submitted to inspection, and have been placed upon the register as providing a satisfactory four-years' course of secondary education. A further increase in the number of State high schools is promised, both in the country towns and the city, and the number of candidates for the final examination is expected to grow rapidly in the next few years.

Written examinations enter only as part of the scheme. The candidates present themselves for the intermediate examination when they have completed an approved two-years' course in a secondary school; they come up for the leaving certificate examination when they have reached the end of an approved four-years' course.

In several minor matters the New South Wales system differs from that upon which it has been modelled, but to these one need not refer. One point, however, must be mentioned; to some it may seem an unnecessary alteration, to others a serious defect. The certificate of the Department of Public Instruction of New South Wales is to be granted on the recommendation of a board of examiners, appointed by the Governor. This board is to consist of four officers of the Department, and not fewer than four professors or other teachers of the University, nominated by the Senate of the University. In other words, the University of Sydney is associated with the Department of Public Instruction in the conduct of the examination.

To explain all the reasons for this association would take too long; nor is it necessary. It is chiefly due to the fact that until recent years the Departments of Public Instruction in the Australian States concerned themselves chiefly with primary education. For the most part secondary education was left to the private schools; or, as in Queensland, to grammar schools receiving a Government subsidy. In these circumstances the universities had organised a system of public examinations, somewhat after the pattern of the Oxford and Cambridge Locals. These public examinations had gained the confidence of the people and set a high standard of attainment. Of course, they had, and still have, some of the vices of all written examinations which are completely divorced from the school work and independent of inspection. But by accepting the cooperation of the University in the examination for the leaving certificate, the Department hopes not only to benefit by the service of skilled and independent examiners, but to graft upon the new system all that is best in the old.

The second event mentioned in the opening sentence is the more important, though it is not unconnected with the first. After prolonged debate, an Act entitled "The University (Amendment) Act, 1912, has been passed. In this Act provision is made for certain changes in the constitution of the governing body of the University of Sydney, and its endowment is materially increased. But these two objects were not the main reason for the introduction of the measure, nor was it either of these which principally attracted public attention. The vital principle of the Bill was that a large number of exhibitions were to be founded, entitling the holders to exemption from fees at the University, so long as they made satisfactory progress with their studies. A fixed number of these public exhibitions is to be allotted each year, the number having a definite ratio to the population. One exhibition is to be given for every 500 persons in the State between the ages of seventeen and twenty,

as shown by the last preceding census. With the present population this works out at 200 per annum. If we take the length of the average course as four years, when the scheme is in full working order there should be 800 students at the University each year, for whom the State would pay.

At first it was intended that the exhibitions should be awarded only to holders of the leaving certificate. However, it was pointed out that in this way a deserving class would be deprived of the benefits of the measure. No exhibition could have been given to the man who desired to enter the University several years after he had left school; nor could one be gained by the lad who had been educated privately, or at a school below the standard required for registration. To remedy this defect, it was provided that, while the exhibitions were to be given each year on the results of the written examination for the leaving certificate, any person other than a candidate for the certificate, who had been a resident in New South Wales for three years, might compete at such examinations, and should be considered equally with the holders of the leaving certificate in the allotment of the exhibitions, except that the number given in any year to these persons should not exceed 5 per cent. of the total for that year.

For this measure the Labour Government of New South Wales is responsible. One of the planks in the policy of that party is free education from the school to the University; and one of the principles for which the party contends is equality of opportunity for the ablest pupils in the schools to advance further with their studies when they have proved their ability and industry. Free university education has not been pressed, but equal opportunity has been demanded, and this measure is meant to provide that opportunity.

The primary and secondary schools of New South Wales are already free; but to make the secondary schools free, and to provide also a large number of exhibitions exempting from fees at the University, is not sufficient to remove the obstacle in the way of an able boy or girl whose parents have only the most moderate means. For such cases additional assistance is required, and for them suitable provision has been made. Bursaries are to be granted to the best pupils of the elementary schools, assisting them, when they stand in need of such assistance, in their passage through the secondary school. On the successful completion of the secondary-school course, University bursaries are given by the State with a similar end in view.

The measure has been criticised in various quarters. Representatives of the professional classes spoke of the cheapening of the professions and of the lowering of the standard. But it was an easy task to answer these objections. The exhibitions are to be granted on the results of an examination in the regulations for which it is expressly provided that the subjects and standards shall be such as the University determines are necessary for matriculation. Also the University shares in the conduct of, and the responsibility for, the examination. The difference which this measure has made is that in New South Wales the boy whose parents cannot afford the fairly large expense of university education will not be cut off from the chance of gaining its benefits, if he proves himself to possess distinct ability and application.

The only serious vital criticism of the measure was that which pointed out that the increase of 10,000*l.* in the endowment of the University would not cover the ultimate loss it would suffer from the non-payment of fees and enable it to meet the other charges imposed upon it by the Bill. The University has, however, no real cause to be anxious on this account; it possesses the confidence of the people, and it is receiving each year largely increased sums of money on the Estimates. So far as this measure is concerned, Mr. Carmichael, the Minister for Education, to whom it is due, stated the situation in the Legislative Assembly as follows:—

"I have given my word on behalf of the Government that before 1916, when the University will receive the full flow of graduates, we shall increase the statutory endowment to meet the demands. I propose, if the Government has an opportunity—and, if not, I hope our successors will recognise the obligation—to raise the endowment in 1915 by another 10,000*l.* From the present day on to 1915 the University is to the good on this deal. I think we may fairly claim to have shown a liberality to the University which I hope our successors in office—if we do not remain here—will follow up. After 1915 the endowment will be increased to meet the requirements of the future."

It is now two years since the change of Government in New South Wales which for the first time gave the power into the hands of the Labour Party. These two years have been marked by great advances in the cause of education from the lowest to the highest level. To those who watch the evolution of democratic government in Australia it may be an interesting fact that, where the democratic tendency is most marked, the claims and advantages of the highest education have their strongest advocates and fullest recognition. New South Wales and Victoria have the advantage over the other Australian States which accompanies larger resources, a greater population, and further development. They have been able more thoroughly to undertake the work of school and university education, and so far as this State is concerned, it may be claimed that the leaders of the democracy, to whatever party they belong, have already abandoned the idea that the highest work can be done without the highest educational preparation for it.

H. S. CARSLAW.

RECENT WORK ON INVERTEBRATES.

THE *Entomologists' Monthly Magazine* for December, 1912, contains two beautifully coloured plates of Lepidoptera, illustrating new and rare species described by Messrs. Hamilton and Herbert Druce and Dr. T. A. Chapman.

In concluding, in the same issue, their notes on the British representatives of the leaping beetles of the genus Longitarsus, Messrs. Tomlin and Sharp direct attention to the apparently instable state of evolution of these beetles, some individuals of a species being winged, while others are apterous. This condition seems to point to the progressive disappearance of the wings in the group; and it is suggested that this may be due to the development of the saltatorial powers. Why it should be more advantageous to jump than to fly is not, however, very apparent, although it may be that the former mode of progression facilitates escape from enemies. A similar suggestion, it may be remembered, has been made in the case of the jumping Australian mice and rats, as compared with ordinary mice and rats, the leaping movement not improbably tending to baffle birds of prey.

In the second part of *Verh. Naturhist. Vereins der preuss. Rheinlande u. Westfalens* for 1911 (1912), Dr. C. Röttgen completes his long account of the beetles of Rheinland. In the same issue Dr. F. Haas

discusses the geographical distribution of the west German Unionidæ, including extinct forms.

The manner in which spiders make their webs forms the subject of editorial notes in the December number of *The Country-Side*. It is stated that all the published accounts which have come under notice describe spiders as constructing their webs in narrowing circles from the periphery towards the centre; but first-hand evidence of the opposite mode of procedure (that is, working from the centre outwards) is cited, and the writer concludes that the published descriptions refer only to the repair of broken webs.

In the introduction to an elaborate monograph of the crinoids of the Indian Ocean, forming part 7 of "Echinoderma of the Indian Museum," published at Calcutta, Mr. A. H. Clark dwells on the extreme richness of the crinoid fauna of this area, which he regards as representing the stock that has given origin in the past to similar faunas in many other parts of the world. Nearly 400 Indian forms are now known, of which about 350 are comatulids and the remainder stalked types. They are arranged in nineteeen families, with eighty-two genera, all the species being peculiar to the Indian region. The only family absent from this is the monogeneric Holopidæ. "All the genera of the Atlantic, Antarctic, and Arctic Oceans are closely related to East Indian genera, from which they were evidently derived in the remote past; but in many cases a single East Indian genus has apparently given rise to two or more Atlantic genera, all nearly equally related to the parent stock." It is also stated that crinoids may be utilised for obtaining an idea of the nature of the plankton of the seas in which they grow, thus affording a clue as to the suitability, or otherwise, of any given area for the support of food-fishes, sponges, coral, or pearl-oysters.

The fifth part of vol. x. of the Annals of the South African Museum is devoted to an account by the Rev. T. R. R. Stebbing of the local representatives of the group of small marine crustaceans known as Sympoda, or—if we follow the Cambridge Natural History—Cumacea. Although the members of the group are readily distinguishable from other crustaceans, their classification is a matter of difficulty, owing to the interlacing of characters and the existence of fine gradations. The author, who recognises a larger number of families than is adopted in the work cited, describes nine genera and fourteen species as new.

The pseudo-scorpions of the country form the subject of vol. x., part 4, of the Annals of the South African Museum. According to the author, the Rev. E. Ellingsen, less than half-a-dozen local representatives of the group were known at the beginning of the century, but the list is now very large, and has been increased in the article before us. The type genus, Chelifer, it is pointed out, will ere long have to be divided.

R. L.

FOAM STRUCTURE OF METALS.

IN a paper on the "foam structure" of metals, in *The International Journal of Metallography* (iii., 1), Prof. Quincke gives a summary of the conclusions which he states as the result of researches dating from 1858 to the present day. While Prof. Quincke's views may well claim respectful consideration, his statement of them in the present paper is far from convincing, and his effort to extend to metals his theory of foam structure of matter appears to be singularly strained. To begin with, there is the fundamental assumption that before solidification commences even in a "pure" metal the liquid becomes heterogeneous, being divided into foam-cells by minute cell-walls differing in viscosity and surface-tension from the cell-contents. Quincke supposes these to be so minute that experimental evidence of their existence cannot be obtained, and he depends for the justification of his assumption upon the power of his theory to explain all the known phenomena of the structure and properties of metals. The present paper gives an outline of this explanation, but while it is distinctly ingenious it suffers from the defect that its author is obviously incompletely acquainted with the modern developments of metallography. As a result, one finds again and again that the proffered explanations are incompatible with well-established facts. One example, out of many which might be given, must suffice.

According to Quincke, the growth of crystals during annealing is due to the collapse of a foam-wall lying between two adjacent foam-cells, and forming what is usually termed an intercrystalline boundary, with the consequent coalescence of the two adjacent crystals into a single crystal. Direct observation of the process of crystal growth has, however, definitely shown that this is not the true *modus operandi*. The crystals do not grow by the bodily absorption of their neighbours, but by a process which may be likened to gradual invasion and conversion. The growing crystal gradually pushes its boundary outward int its neighbours, and frequently does so by pushing out one or more arms which gradually spread laterally as well as advance longitudinally. Nothing could be more unlike the picture suggested by Quincke's explanation, and similar difficulties can be raised at every turn.

On reading the paper, however, while those intimately acquainted with the behaviour of crystalline aggregates will scarcely be disposed to accept the "foam-cell" theory, they will yet be struck by the fact that the forces of surface-tension upon which Quincke lays such stress must powerfully affect the structure of metals and alloys—forces the importance of which has not perhaps been sufficiently recognised by current metallographic theories. In eutectic alloys particularly one constantly meets with structures which bear strikingly close resemblance to those assumed by films of liquid under the action of surface-tension. It has even been thought that the constituents of such eutectics may assume their actual forms just before solidification, in the shape of bags or sacks of the kind imagined by Quincke as foam-cells.

Experimental evidence is, however, against this view. The experiment has been tried of allowing eutectic alloys to solidify slowly under the action of centrifugal pressure in a powerful centrifuge, and the resulting structure is entirely unaffected. Had liquid sacks or "foam-cells" really been formed they must have been flattened or deformed under this treatment, but such was not the case. On the other hand, recent metallographic researches seem to indicate that the intercrystalline boundaries of a metal are of the nature of cell-walls formed by very thin layers of the same metal in the amorphous or undercooled liquid state, and here there is a decided approximation to Quincke's ideas, only that these cell-walls are regarded as the result of the meeting of adjacent growing crystals, and not as the primary limitations to crystal growth. Still, although Quincke's theory of foam-cells can scarcely be accepted as being in reasonable accordance with the known facts of metallography, a study of his views should be useful and suggestive to all those interested in the physics and physical chemistry of crystalline aggregates.

W. ROSENHAIN.

THE MELBOURNE MEETING OF THE AUSTRALASIAN ASSOCIATION.

THE Australasian Association for the Advancement of Science met at Melbourne, under the presidency of Prof. T. W. E. David, F.R.S., on January 7–14. The meeting proved most successful. There was a large and representative gathering of members from all the Australian States and New Zealand. Owing to the approaching visit of the British Association, it was decided to postpone the Hobart meeting, which in the ordinary course of events would have been fixed for 1915, until the beginning of 1916, and the cordial invitation, which the New Zealand delegates brought, that the succeeding meeting be in Wellington, was accepted.

The subject of the presidential address was "The Australian Climate, Past and Present," but before passing to it, Prof. David spoke of the interest the Federal Government had shown in scientific work relating to the Commonwealth. Its action in organising the recent scientific expedition to the northern territory, under Prof. Baldwin Spencer, and in arranging for his presence there for the last year, had commended itself both to the general public and to workers in science. The reports already published showed that the northern territory had far greater possibilities than most people had imagined, in regard both to its pastoral and mining features. The appointment of a man of science, Prof. Gilruth, to the important position of administrator was a step for which the association was grateful to the Government.

Papua also had not been neglected, and the mission of Mr. Carne to that country had been most successful. Among other things, he had located an extensive belt of oil-bearing sandstones, which he believed to be an extension of the great Burmese oil-belt, which ran through Sumatra, Borneo, and Java, to Timor, and thence to New Guinea. The oil-belt was full of possibilities, and he thought there was no more fascinating field for exploration than this island.

Dealing with the Australian climate, Prof. David spoke of the importance of the scientific observations of the Antarctic expeditions, especially those of Capt. Scott and Dr. Mawson. The meteorological data, communicated by wireless telegraphy from Macquarie Island by members of Mawson's expedition, showed most distinctly the association between the weather conditions of Australia and those of the subantarctic. It was to be hoped that in the near future some joint arrangement would be made between the Governments of Australia and New Zealand, providing for the continued upkeep of the station on that island.

From the evidence he had collected, he believed that the reason for the great climatic and biological differences between the north and south polar regions is mainly geographical; that it depends on the present distribution of land and water, and on the modifications which they introduce into the circulations of air and water in either hemisphere. The existence of the large continent of Antarctica, with an average elevation of about 6000 ft., acts as a great refrigerator in the southern hemisphere, and causes extremes, which otherwise would not exist, between the south polar and equatorial temperatures. This factor tends to increase the rapidity of air circulation in the southern hemisphere. It accounts for the periodic fierce outrushes of blizzard winds, which accompany the development of the Antarctic low-pressures, and often profoundly affect Australian weather conditions.

On the other hand, the absence of land in the north polar regions, and the presence of open water in the summer, cause the temperature in those regions to be much higher at that season in the Arctic than in the Antarctic.

In the course of his address, Prof. David made particular reference to the need for further development of the Department of Meteorology in Australia, and he stated that there was every prospect of the Federal Government making the Australian Solar Physics Observatory an accomplished fact in the near future.

A noteworthy feature of the meeting was a lecture on the northern territory and its aborigines, delivered in the Melbourne Town Hall, by Prof. Baldwin Spencer, who had just returned after a year's absence in the territory on a special mission from the Federal Government. The Governor-General and the Prime Minister were present, and the large hall was crowded long before the hour at which the lecture commenced.

Prof. Spencer began by a reference to the vastness of this part of Australia. It was four and a half times as large as Great Britain, but its population, excluding the aborigines, was less than 4000; and of the aborigines he did not think there were more than 40,000. The Commonwealth Government now had control of this region, and it had organised a series of important departments in which work of a valuable character was already being performed. It was necessary to remember that for forty years practically very little had been done in the territory. Now they had in their administrator a strong, straight, and fearless man, who had quickly won the complete trust and confidence of everyone working under him. The climate was undoubtedly trying, particularly in the wet season, which extends from March until September. But inland, on the "downs" country, it is infinitely better than on the coastal fringe. He believed that this cool winter climate would make a very great difference in the opening up, at any rate, of these inland regions, and the existence of these cooler temperatures at certain seasons of the year made the country differ from other tropical regions where such changed conditions were unknown.

Dealing with the natives, he was able to show the audience by kinematograph views and phonograph records some of the results of his investigations. A stay of about two months had been made on a station in the Alligator River district, and this time devoted wholly to acquiring information upon the habits, beliefs, and customs of the natives. He found these differed somewhat from those of the southern tribes.

A visit had also been paid to Melville Island, some forty miles from the mainland, which he reached in a small lugger from Port Darwin. The aborigines inhabiting that island were of a better type than those on the mainland. He saw ceremonies performed which were entirely new to him, notably a weird performance in connection with the burial of a man. A small plot of ground having been cleared of vegetation, a number of fantastic grave-posts were placed upright in the ground on either side of the prepared spot. Some fifty natives lined up, after the fashion of soldiers, whilst four other men ran between and around the grave-posts, stamping with their feet, which action was supposed to drive the spirit of the departed into the ground. Other films depicted the islanders in the canoes, in which they often negotiated the stretch of open ocean between the island and the mainland, forty miles across.

In his concluding remarks, Prof. Spencer said that the natives of the northern territory had certain attributes of a high character. Undoubtedly it was a great problem to know what to do with them; their entire lack of knowledge of agricultural methods rendered the problem all the more difficult of solution. He hoped very shortly to lay a scheme before the

Government whereby they would be in great reserves, protected from contaminating influences, and led to a higher and better life.

Many papers were communicated to the various sections, but limitations of space will not permit us to describe them. The presidents of sections and the subjects of their addresses, where this information has reached us, were as follows:—A, "The Relation between Pure and Applied Mathematics," Prof. H. S. Carslaw; B, Prof. C. Fawsitt; C, "The Evolution of the Physiographic Features of South Australia," Mr. W. Howchin; D, "The Present Aspect of Some Problems of Heredity," Prof. H. B. Kirk; F, Practical Aspects of Anthropology," Dr. W. Ramsay Smith; G, Observations regarding the Production and Distribution of Consumable Wealth and Economic Capital, with an Inquiry into the Probable Effect of Arbitrary Regulations of Minimum-wage Standards upon the Cost of Living; H, "A Review of the Existing Conditions of the Twin Professions of Engineering and Architecture in Australia"; K, "The Relation of Fertilisers to Soil Fertility," Mr. F. B. Guthrie.

A large number of reports received the approval of the general council of the association, but we can only refer to a few of them.

It was approved that a committee be appointed with instructions (*a*) to bring under the notice of the Federal Government the desirability of its providing for a re-determination of the difference of the longitudes of Singapore and Darwin, and of the differences of longitude of the Australian observatories from each other; (*b*) to communicate with the Indian Government with respect to the possibility of re-determining the difference between Madras and Singapore.

Prof. David brought up a recommendation that in view of the already proved importance to pure science, to weather forecasting, and to shipping, of the meteorological station and wireless installation at Macquarie Island, a committee be appointed with power to add to its number to take all steps necessary to maintain the station on a permanent basis. Macquarie Island is situated just half-way (*a*) between Australia and New Zealand, and (*b*) between both those countries and the Antarctic continent.

In the reports presented to the Glacial Research Committee, Prof. W. G. Woolnough records an extensive area of Permo-Carboniferous glacial beds discovered by him on the Manning River and the Macleay River, some 150 to 250 miles north of Sydney. The Boulder beds are associated with marine strata, and near Tane, on the Manning River, the more southern locality, the boulders are embedded in limestone. This occurrence is compared with the marine glacial beds of Jervis Bay, New South Wales. Mr. R. Speight summarises the results of recent investigations into the glaciation of New Zealand.

It was resolved that in view of the rapid decadence and disappearance of the Australian aborigines it is urgent that, in the interests of science, further records and collections, illustrative of the beliefs, customs, and manner of life of the aborigines should be made for public preservation, more especially with reference to Queensland and Western Australia. It was resolved also to take such steps as may be deemed necessary to enforce the existing law with regard to the exploration of anthropological material, and further to prevent the indiscriminate exportation of other anthropological and ethnological specimens from any part of the Commonwealth.

A committee was appointed to consider the best means of securing the efficient teaching of English pronunciation in Australasian universities, training colleges, and schools.

A committee appointed at the Sydney meeting, 1911, brought up a progress report on the steps to be taken with the view to the compilation of a list of the scientific serial periodical literature, both in public and private possession, in each of the principal cities of Australia.

REPORTS OF THE SMITHSONIAN INSTITUTION.[1]

THE report of the secretary of the Smithsonian Institution for the year ending June 30, 1912, has been received from Washington. The general report reviews the affairs of the institution proper, with brief paragraphs relating to its several branches. The numerous appendices provide, in addition, detailed reports of the work—placed by Congress under the direction of the Board of Regents of the Smithsonian Institution—in the United States National Museum, the Bureau of American Ethnology, the National Zoological Park, and some four or five other organisations.

It is worthy of note that the total permanent fund of the institution amounts to 197,384*l*. The income for the year was 21,432*l*., of which 11,675*l*. was interest on the permanent fund. The disbursements for the year amounted to 21,107*l*. More than this, the institution was responsible to Congress for the spending of the grants to the scientific organisations named above, and these reached a total of 148,400*l*.

The report of the Board of Regents consists of two main divisions: first, the annual report of the secretary, giving an account of the operations and conditions of the institution for the year ending June 30, 1911, and following the same general lines as the more recent report by the secretary dealt with above; and, secondly, the general appendix, comprising a selection of miscellaneous memoirs of interest, chiefly belonging to the year 1911, likely to be useful to men of science and others.

Among the original contributions to the general appendix is one by Mr. F. Alex. McDermott, of Washington, on recent advances in our knowledge of the production of light by living organisms; others are by Mr. N. C. Macnamara, on organic evolution: Darwinian and De Vriesian; by Mr. Paul C. Standley, on some useful native plants of New Mexico; and by Mr. William R. Maxon, on the tree ferns of North America.

Prof. A. M. Tozzer, of Harvard University, in a paper reprinted from the Proceedings of the American Antiquarian Society (Worcester, Mass., April, 1911), gives much interesting information concerning the value of ancient Mexican manuscripts in the study of the development of writing. These manuscripts, and those of Central America, constitute important examples of primitive ideas regarding art and illustration, as well as data of great ethnological value. The countries of Mexico and Central America are the only fields of the New World where any appreciable data on prehistoric life other than monuments, implements, and other objects are found. The manuscripts of Mexico are divided by Prof. Tozzer into two classes—those written before the advent of the Spaniards, and those written during early Spanish occupation.

Prof. Tozzer describes the manuscripts under discussion, and follows the development of writing from the period of reminders or mnemonics, to actual pictures, from them to a symbolistic and conventional

[1] Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1912. (Washington: Government Printing Office, 1912.) Annual Report of the Board of Regents of the Smithsonian Institution showing the Operations, Expenditures, and Condition of the Institution for the Year ending June 30, 1911. (Washington: Government Printing Office, 1912.)

ideographic system, thence to characters expressing sounds as well as ideas, and the beginning of syllaby, the first step in the development of phonetic writing. The Spanish priests made the last advance, in the form of an alphabet, by selecting syllabic characters to express initial sounds.

The volume is rich in translations, and among these may be mentioned an article by M. H. Marchand from *Cosmos,* on the invention of the gyroscopic compass and its practical utilisation on board ship; that by Dr. Jules Courmont, from the *Revue générale des Sciences,* on the sterilisation of drinking water by ultra-violet radiations; that by Dr. M. Philippot, in the "Annuaire Astronomique pour 1912," Belgium, on the legal time in various countries; that by Prof. S. Pozzi, from the *Revue scientifique,* on the garden of serpents, Butantan, Brazil; the translation from the German of Mr. W. Belck, in *Zeitschrift für Ethnologie,* under the title "The Discoveries of the Art of Iron Manufacture"; that of Mr. A. Lissauer's article, from the same German source, on the Kabyles of North Africa; and of Dr. A. F. Legendre's article in the *Revue de l'Ecole d'Anthropologie,* on the Lolos of Kientchang, western China.

Among the numerous reprints from English journals and magazines a small selection only can be given. We notice Sir David Prain's obituary notice of Sir Joseph Hooker, which appeared in NATURE for December 21, 1911. Numerous Royal Institution discourses are included, such as Commendatore Marconi's on radio-telegraphy; Prof. Wood's on recent experiments with invisible light; Prof. Richards's Faraday lecture on the fundamental properties of the elements; and Prof. H. S. Hele-Shaw's on travelling at high speeds on the surface of the earth and above it.

The addresses delivered at the meetings of the British Association also have been drawn upon, Sir William Ramsay's presidential address at the Portsmouth meeting being given a prominent place.

As usual, the illustrations are numerous and excellent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SIR JOHN RAMSDEN has sent a subscription of 1000*l.* to the fund which Mr. Austen Chamberlain is raising for the extension of the London School of Tropical Medicine.

WE learn from *Science* that by the death of Mr. J. Lyman, Yale University will received 130,000*l.* He held the life interest in that sum, which was willed to the college by his brother, the late Mr. S. Lyman, who died in 1910. From the same source we find that both houses of the legislature of the State of Washington recently adopted the biennal budget. The University of Washington will receive a grant of some 201,000*l.* The matter of the replacement of the temporary university buildings by adequate modern structures has been submitted to the legislature separately. The recently adjourned legislature of West Virginia, too, voted larger grants to the State University than in any previous year.

A COPY of the programme of the Irish Training School of Domestic Economy for the session 1913–14 has been received from the Department of Agriculture and Technical Instruction for Ireland. The school is a residential institution, maintained by the Department for the purpose of training teachers of domestic economy, and also for providing a training in household management for girls who have already received a satisfactory general education. The school is situated at St. Kevin's Park, Kilmacud, Stillorgan, co. Dublin. The premises stand in grounds of about three acres. The house provides ample accommodation for the staff and students, in addition to class and recreation rooms. A large fruit and vegetable garden is attached to the house.

A NEW provincial technical college was opened at Workington, Cumberland, on Friday, March 14, by Sir John S. Randles, M.P., in the presence of a distinguished company. The college provides a complete course of day and evening training for students in engineering and metallurgy, serving especially the needs of the district. It is intended to commence day apprentice classes in connection with the local iron and steel works in September next. Inasmuch as the premises are used in the daytime for the accommodation of a day secondary school and a trade preparatory school, a complete scheme of education and instruction is provided. The school buildings comprise a block of twelve class-rooms, many specially fitted for the teaching of some specific subject, together with chemical, physical, mechanical, mining, and metallurgical laboratories, art-rooms, dining-hall, cookery-room, laundry, woodwork and metalwork shops, and the usual administration rooms. A gymnasium is in course of erection, and it is proposed to stablish a hostel for boys and girls in order to overcome the usual geographical disabilities suffered by children in rural districts. The school generates its own electric current for lighting and power purposes, and a complete and elastic system of distribution has been arranged. Each class-room is fitted with a small table, with gas, water, and waste arranged, so that illustrative work may be carried out in any room; electric lanterns are also available in each class-room and laboratory. The building has been erected at a cost of nearly 30,000*l.* It is situated at the railway centre of west Cumberland, and already its accommodation is taxed to the utmost. There are well above 300 scholars in the daytime, and more than 500 evening students at present in attendance. The college is the only technical college in Cumberland, and it is financed out of county higher education funds. The staff numbers twenty full-time members. In opening the college, Sir John Randles (who had previously given a scholarship value 50*l.*) presented the governors with the sum of 1000*l.*, the interest upon which was to be used in giving a student of the metallurgical department a travelling scholarship for the purpose of visiting metallurgical centres abroad.

THE International Kinematograph Exhibition and Conference was held at Olympia on March 22–29 inclusive, and aroused the keen attention of many distinguished people in various branches of knowledge. Though no advance in the general science of kinematography could be seen, there were many improvements of detail on view in machines, in films, and in pictures. Two kinematograph projector machines shown by Messrs. Pathé Frères (one suitable for the class-room and the other for the theatre, both of which could be worked by being attached to the electric lighting current), represented one of the finest productions of mechanical art in every way. Their uses for educational means are further enhanced by the very great safety of using non-inflammable films and by the possibility of stopping the projector so as to display a still picture in case the teacher wished to describe or explain it. The pictures reflected great credit on the enterprise of the firms exhibiting, but except for one firm, already mentioned, no attempt had been made to produce pictures of direct educa-

tional bearing. The kinematograph trade would be well advised to consult educationists in order that its films may be produced with the requisite essential of scholarship and art, without which they may be only entertaining or useless or positively harmful. The Educational Conference, organised by Mr. A. P. Graves, was most successful. Addresses dealing with the various educational uses of the kinematograph were delivered by Canon Lyttleton, Mr. A. P. Graves, Miss Von Vyss, Dr. Sleight, Mr. F. W. Sanderson (headmaster, Oundle School), Mr. A. Burrell, Mr. Morley Dainow, Dr. Hayward, Prof. R. A. Gregory, and Miss Marsh. Amongst the chairmen were Sir A. K. Rollit, Dr. Kimmins, and Prof. Lyde. The discussions were vigorous, and many headmasters, teachers, doctors, civil servants, and representatives of educational organisations took part, while amongst the audience were two representatives of the Board of Education. The essence of the discussion was that the power of the kinematograph as an educational force is enormous. Every attempt should be made to guide and control it. Three important resolutions were passed embodying these views, and a committee was appointed to carry them out. The proceedings of the conference are being compiled by Mr. Morley Dainow.

LORD HALDANE addressed a large joint meeting of secondary- and technical-school teachers on March 29 at the University of London. There is a notion in the head of the man in the street, said the Lord Chancellor, that secondary education is a luxury with which he need not trouble himself, and so long as that notion is in his head it will be very difficult to get him to pay any taxes for secondary education. But if it can be brought home to him that the state of the education question in this country is at this moment a peril to the nation and that it is a question of national safety with which we are dealing, then he will take a larger view. We are behind the level which has been reached by several of our competitors, a level which will put us in peril. We cannot dissociate national progress from the basis of knowledge even when it comes to the question of making money; and if the level of the national income is to be maintained, if our industrial pre-eminence is to stand, Lord Haldane said deliberately that the nation will have to make an effort to put its educational system in order. One reason why the universities have suffered is because we have never understood fully the significance in the educational system of the secondary school. In Germany it has been different. The whole educational fabric there rests upon the basis of the secondary school. The boy goes into the secondary school young, and remains there if he goes through the full course for about nine years, and at the end of that time he is so qualified that he goes straight to the university. There is no matriculation examination, but the student has to produce his entrance certificate showing that he has gone through the mill and has been in the atmosphere of the secondary school. We have, continued Lord Haldane, outgrown the period of the old-fashioned examination. What we want is a record, and everybody who goes to the university should have that record. The time has not yet come when we can deprive the external student of his chance of getting an external degree. It will come when people realise that the external degree means nothing comparable to the degree which is the hall-mark of having lived in the atmosphere of the university. Education is the greatest reform we can take in hand, and expenditure on education is productive expenditure which we are justified in making a sacrifice to incur.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, March 14.—Dr. A. Russell, vice-president, in the chair.—Dr. J. A. **Fleming**: (1) Some oscillograms of condenser discharges and a simple theory of coupled circuits. A short method for arriving at a formula for the time of free electrical oscillation of a leaky condenser in series with an inductive resistance, the oscillations being damped. The formulæ can be confirmed by oscillograms taken at low frequency with a Duddell oscillograph. (2) Some Braun kathode-ray tubes used as high-frequency oscillographs, and an electrostatic influence machine, giving a steady current of 300 to 350 microamperes for working them. The Braun tubes have electrostatic deflection plates in them and an embracing field coil for providing a longitudinal field to keep the kathode spot in a central position on the screen.—B. B. **Baker**: Stretching and breaking of sodium and potassium. Wires made of metallic sodium and potassium collapse when stretched, not to a point, as is the case with most plastic substances, but from two opposite sides only, into a chisel end. Wires made by running the metal, molten under oil, into a glass tube and allowing it to solidify, also showed, on extension, two sets of equidistant rings on their surface, each inclined at an angle of 45° to the axis, the rings of opposite sets touching along the line of greatest thinning and bisecting one another along the line at which no thinning takes place.—R. G. **Lunnon**: The latent heat of evaporation of steam from salt solutions. The experimental method was to supply a measurable quantity of heat electrically to the solution boiling inside a calorimeter. The steam from the inner vessel passed into a detachable condenser, which was weighed at intervals. The difference between the measured heat L, and l, the known heat of evaporation of water, is the heat of solution Q; and the present results indicate that for salts of the same acid Q is proportional to the concentration.

Zoological Society, March 18.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—Miss Edith E. **Bamford**: Variations in the skeleton of the pectoral fins of Polypterus. An examination had been made of the material brought back by Budgett from his West African expeditions, in order to account for the discrepancies which occur in the descriptions of the fins of Polypterus as given by different investigators. These discrepancies were found to be due to the very numerous variations in the fins and to the previous scarcity of material. A description is given of the variations found in the radials, mesopterygium, propterygium, metapterygium, and the distal cartilages, and their bearing on the different descriptions and the theories of other investigators is indicated.—Dr. H. H. **Stirrup**: A descriptive study of an Oligochæte worm of the family Enchytræidæ. A number of new and interesting observations were recorded, including an account of the structure and significance of the so-called "septal glands," which had been found to contain two definite anatomical components.—Dr. W. **Yorke**: The relationship of the big game of Africa to the spread of sleeping sickness. The author states that sleeping sickness in Nyasaland and Rhodesia is due to a different parasite from that causing the disease in other parts of tropical Africa. In these countries the disease is transmitted by *Glossina morsitans* and not by *G. palpalis*. As *G. morsitans* is ubiquitous, and not limited in its distribution to water-courses, this fact has an important bearing on the measures that can be recommended with a view to prophylaxis.

Geological Society, March 19.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—B. **Thompson**: The geology of northern Peru: Tertiary and Quaternary beds. Some 600 square miles of territory in the westernmost part of South America, between the fourth and fifth degrees of south latitude, are dealt with. A great uplift and folding of the rocks took place in late Oligocene or early Miocene times, followed by a comparatively short terrestrial epoch. A subsequent depression allowed of the deposition of Miocene and possibly later beds. In recent ages the area has been spasmodically rising. The exposed rocks probably attain a thickness of 5000 ft. or more. Eight palæontological zones are established, and about 150 species of fossils are recorded. The origin of the petroleum is traced to animal organisms.—G. A. **Frost**: The internal cranial elements and foramina of *Dapedius granulatus*, from a specimen recently found in the lias at Charmouth. Owing to the envelopment of the skull and its pyritisation, the bones and interorbital septum are preserved in perfect condition. There is no foramen in the parasphenoid in front of the basipterygoid processes, as in Lepidotus. The basicranial canal differs from that in *Amia calva*, in its extension to the rear of the skull.

CALCUTTA.

Asiatic Society of Bengal, March 5.—F. W. **Edwards**: Tipulidæ and Culicidæ from the Lake of Tiberias and Damascus. Three species at least are new to science, one of them (the Uranotænia) being the first of its genus to be found within the Palæarctic region. The occurrence of *Conosia irrorata* makes a notable extension of the known range of this widely spread species.—F. H. **Gravely**: A preliminary account of a revised classification of Indo-Australian Passalidæ. The Passalidæ inhabiting the Indo-Australian region can conveniently be divided into six subfamilies. This necessitates a rearrangement of the recognised genera, and the erection of a new genus with *Tiberius kuwerti*, Arrow, as type.—J. S. **Gamble**: Materials for a flora of the Malayan Peninsula, No. 24.—Capt. R. B. Seymour **Sewell**: Notes on the biological work of the R.I.M.S. *Investigator* during the survey seasons 1910–11 and 1911–12.—E. **Ghose**: The internal anatomy of the blind prawn of Galilee (*Typhlocaris galilea*, Calm).—C. F. **Rousselet**: A note on Rotifers from Galilee. Recognisable specimens of four widely distributed species were found in a tow-netting taken on the surface of the Lake of Tiberias in October, 1912; while two sessile forms were reared in Calcutta in large numbers from dried mud from the bed of a small pool between Tiberias and Nazareth. One of these (*Occister socialis*, Weber), although widely distributed, is a rare species.—B. L. **Mukherji**: The identification of the Soma plant.—M. H. **Shastri**: The ancient civilisation of Bengal. The early inhabitants of Bengal were not Aryans, but a race known for their industry and commerce, colonisation, and philosophy. Buddhism took its rise on the borderland of the Aryan culture, and it owed more to eastern India than to western India.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part vii., for 1912, contains the following memoirs communicated to the society:—

January 13.—P. **Koebe**: Foundations of the continuity method in relation to conformable representation and uniformisation (preliminary considerations).

May 28.—W. **Voigt**: Electric and magnetic double refraction (ii.).

June 22.—L. E. J. **Brouwer**: The freedom from singularities of the modular manifold.—P. **Koebe**: A new method of conformable representation and uniformisation.—W. **Behrens** and E. **Hecke**: The rectilinear motion of Born's rigid electron.

July 6.—G. **Tamman**: The method of determining p-T-lines for the construction of phase diagrams.

August 22.—D. **Hilbert**: Foundations of the elementary theory of radiation.

October 26.—G. **Tamman**: The theory of polymorphism (in crystals).—W. **Voigt**: Electric and magnetic double refraction (iii.).

November 23.—F. **Körber**: The relations between the volume-surfaces of the isotropic and anisotropic phase, and the course of the neutral curve, $\Delta v=0$.

December 7.—A. von **Koenen**: The geological relations of the southern Reinhard and Bram Forests, especially on the Münden-Blatt.

The supplement contains a long paper by L. Schlesinger on Gauss's memoirs on the theory of functions, being part iii. of the "Materials for a Scientific Biography of Gauss," collected by F. Klein and M. Brendel.

BOOKS RECEIVED.

The Story of the Forth. By H. M. Cadell. Pp. xvii+299+plates+maps. (Glasgow: J. MacLehose and Sons.) 16*s*. net.

Union of South Africa. Mines Department. Geological Survey. The Geology of the Country round Warmbaths and Nylstroom, including the Rooiberg Tinfields. By H. Kynaston and Dr. E. T. Mellor. With notes by Dr. W. A. Humphrey. Pp. 52. (Pretoria: Government Printing and Stationery Office.) 2*s*. 6*d*.

Planetologia. By Ing. E. Cortese. Pp. vii+387. (Milano: U. Hoepli.) 3 lire.

Einführung in die höhere Mathematik für Naturforscher und Aerzte. By Dr. J. Salpeter. Pp. xii+336. (Jena: G. Fischer.) 12 marks.

Memoirs of the Department of Agriculture in India. Veterinary Series. Vol. i., No. 1. Anaphyloxis in the Larger Animals. By Dr. J. D. E. Holmes. Pp. 86+iii plates. Vol. i., No. 2. Salvarsan in the Treatment of Surra in Horses, Dogs, and Rabbits. By Dr. J. D. E. Holmes. Pp. 89–148. (Calcutta: Thacker Spink and Co.) 2 rupees and 1.4 rupees respectively.

Government of India. Meteorological Department. Indian Weather Review, Annual Summary, 1911. Pp. 131–194+ccxxxviii–cccii+vi plates. (Simla: Government Central Branch Press.) 3 rupees.

Thèses présentées a la Faculté des Sciences de Paris pour obtenir le Grade de Docteur ès Sciences Mathématiques. By J. Bosler. 1re Thèse: Sur les relations des Orages Magnétiques et des Phénomènes Solaires. 2e Thèse: Propositions données par la Faculté. Pp. iv+96. (Paris: Gauthier-Villars.)

List of North American Land Mammals in the U.S. National Museum, 1911. By G. S. Miller, jun. Pp. xiv+455. (Washington: Government Printing Office.)

Mind and Health. By Dr. E. E. Weaver. Pp. xv+500. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Ueber Zonenbildung in kolloidalen Medien. By Dr. E. Küster. Pp. x+111. (Jena: G. Fischer.) 4 marks.

Jahrbuch der drahtlosen Telegraphie und Telephonie. Edited by Dr. G. Eichhorn. Band vi., Heft 3-6. (Leipzig: J. A. Barth.)

Lessons on Elementary Hygiene and Sanitation, with Special Reference to the Tropics. By W. T. Prout. Third edition. Pp. xx+184. (London: J. and A. Churchill.) 2*s*. 6*d*. net.

Fauna Hawaiiensis, or the Zoology of the Sandwich (Hawaiian) Isles. Edited by D. Sharp, R. C. L. Perkins, and Prof. A. Forel. Vol i., parts 1 to 6. Vol. ii., parts 1 to 6. Vol. iii., parts 1 to 6. (Cambridge University Press.) Prices various.

Laboratory Text-Book of Chemistry. By V. S. Bryant. Part i. Pp. vii+246. (London: J. and A. Churchill.) 4s. net.

Modern Pumping and Hydraulic Machinery. By E. Butler. Pp. xvi+473. (London: C. Griffin and Co., Ltd.) 18s. net.

Vererbungslehre mit besonderer Berücksichtigung des Menschen. By Dr. L. Plate. Pp. xii+519+3 plates. (Leipzig: W. Engelmann.) 18 marks.

Genetics: an Introduction to the Study of Heredity. By Prof. H. E. Walter. Pp. xiv+272. (London: Macmillan and Co., Ltd.) 6s. 6d. net.

A School Algebra. By F. O. Lane and J. A. C. Lane. Pp. viii+333. (London: E. Arnold.) 3s. 6d.

Pond Life. By E. C. Ash. Pp. viii+94. (London and Edinburgh: T. C. and E. C. Jack.) 6d. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 38 to 40. (Jena: G. Fischer.) 2.50 marks each Lief.

Western Australia. Geological Survey. Bulletin No. 43. Petrological Contributions to the Geology of Western Australia. By R. A. Farquharson. Pp. 100+iv. Bulletin No. 47. The Mining Geology of the Kanowna Main Reef Line, Kanowna, North-East Coolgardie Goldfield. By T. Blatchford and J. T. Jutson. Pp. 106+3 maps+iv. (Perth, W.A.: F. W. Simpson.)

Elements of the Precision of Measurements and Graphical Methods. By Prof. H. M. Goodwin. Pp. 104. (London: Hill Publishing Co., Ltd.)

DIARY OF SOCIETIES.

THURSDAY, APRIL 3.

ROYAL INSTITUTION, at 3.—The Bridge into Life: Dr. E. Frankland Armstrong.

LINNEAN SOCIETY, at 8.—Some Forms of *Alchemilla vulgaris*: C. E. Salmon.—Report on H.M.S. *Sealark*, Calcarea: Prof. A. Dendy.—*Embia major*, sp. nov., from the Himalayas: Prof. A. D. Imms.—A Free-swimming Nauplioid Stage in Palinuris: Dr. J. D. F. Gilchrist.—The Classification of the Order Symphyla: R. S. Bagnall.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Further Discussion*: Some Effects of Superheating and Feed-water Heating on Locomotive Working: F. H. Trevithick and P. J. Cowan.

FRIDAY, APRIL 4.

ROYAL INSTITUTION, at 9.—The Spectroscope in Organic Chemistry: Dr. J. J. Dobbie.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of the Nottingham District: B. Smith.

SATURDAY, APRIL 5.

ESSEX FIELD CLUB (at Essex Museum, Stratford), at 6.—Fairy-flies (Mymaridæ) and their Hosts: F. Enock.

MONDAY, APRIL 7.

ROYAL SOCIETY OF ARTS, at 8.—Aëronautics: Prof. J. E. Petavel.

SOCIETY OF ENGINEERS, at 7.30.—The Status of Engineers and Engineering, with Special Reference to Consulting Engineers: W. Ransom.

ARISTOTELIAN SOCIETY, at 8.—Some Points in Kant's Transcendental Æsthetic: W. W. Carlile.

VICTORIA INSTITUTE, at 4.30.—*Discussion*: The Gunning Prize Essay read on March 17. *Opener*: Dr. J. W. Thirtle.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Production of Steel Sections and their Application in Engineering Structures: A. T. Walmisley.

TUESDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Recent Discoveries of Early Man: Dr. A. S. Woodward.

ZOOLOGICAL SOCIETY, at 8.30.—(1) A Collection of Fishes made by Prof. Francisco Fuentes at Easter Island; (2) A Revision of the Fishes of the Genus Kuhlia: C. Tate Regan.—The Affinities of *Canis antarcticus*: R. I. Pocock.—A Collection of Mammals from the Hebrides, Scotland: Major G. E. H. Barrett-Hamilton and M. A. C. Hinton.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Discovery of a Human Skeleton in a Brick-earth Deposit at Halling, Kent: W. H. Cook.—Description of Human Remains: Dr. A. Keith.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The Yield of Various Catchment-Areas in Scotland: W. C. Reid.—Measurement of the Flow of the River Derwent, Derbyshire: E. Sandeman.—*Probable Paper*: Coastal Sand travel near Madras Harbour: Sir F. J. E. Spring.

WEDNESDAY, APRIL 9.

ROYAL SOCIETY OF ARTS, at 8.—Electric Supply in London: F. Bailey.

AERONAUTICAL SOCIETY, at 8.30.—Propellers: W. O. Manning.

GEOLOGICAL SOCIETY, at 8.—The Variation of *Planorbis multiformis*, Bronn: Dr. G. Hickling.—The Structure and Relationships of the Carboniculæ: Miss M. Colley March.

THURSDAY, APRIL 10.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Various Inclinations of the Electrical Axis of the Human Heart: A. D. Waller.—The Nature of the Toxic Action of the Electric Discharge upon *Bacillus coli communis*: Prof. J. H. Priestley and R. C. Knight.—(1) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. II. The Wild Game Strain; (2) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. III. The Wild *Glossina morsitans* Strain; (3) Infectivity of *Glossina morsitans* in Nyasaland: Surg.-General Sir D. Bruce, Majors D. Harvey and A. E Hamerton, and Lady Bruce.

ROYAL INSTITUTION, at 3.—Colour in Flowers: Dr. E. Frankland Armstrong.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Self-synchronising Machines (Self-starting Synchronous Motors and Rotary Converters): Dr E. Rosenberg.

CONCRETE INSTITUTE, at 7.30.—Structural Engineering: E. F. Etchells.

FRIDAY, APRIL 11.

ROYAL INSTITUTION, at 9.—The Winds in the Free Air: C. J. P. Cave.

PHYSICAL SOCIETY, at 8.—Some Errors in Magnetic Testing Due to Elastic Strain: A. Campbell and H. C. Booth.—Note on Kathodic Spluttering: Dr. G. W. C. Kaye.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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THURSDAY, APRIL 10, 1913.

THE HERITABLE RESULTS OF CHANGED NURTURE.

Das Problem der Vererbung "erworbener Eigenschaften." By R. Semon. Pp. viii+203 (Leipzig: Wilhelm Engelmann, 1912.) Price 3.20 marks.

RETURNING to the much-discussed question of the transmission of acquired characters, Prof. Richard Semon goes over the whole ground. Conclusions—both affirmative and negative—have been based on certain sets of data, but all the facts must be faced if we are to form a sound judgment. This is indeed what many biologists have tried to do. The first chapter, which is historical, includes the commendable suggestion that it is time to stop using inexact terms like "Lamarckism," so often taken as synonymous with the theory of the transmission of acquired modifications. In the second chapter the author formulates the question at issue: A stimulus sets up an excitation in a parental body; the residual effect of this excitation is a change in the reaction-capacity (an "Engramm"); can we say that in favourable circumstances there results a change in the hereditary potency of the germ-cells, and of such a nature that the offspring show a change in the same direction as that exhibited in the parent?

Prof. Semon begins his survey of the evidence by considering language, acquired knowledge, and training; and while he does not claim to prove anything, he refers to cases which suggest that individual experience must count somehow. Why is it, for instance, that a young buzzard, taken from the nest, treats an adder quite differently from a grass-snake? Has experience not counted at all in the evolution of this inborn power of discrimination? The fourth chapter brings together numerous interesting cases which suggest the inheritance of engramms. Young acacias with an "inherited disposition" to a certain rhythm of sleeping and waking will, as it were, try to give expression to this in quite unnatural conditions of illumination and darkness. Braus has shown that if the fore-limb be removed from the larva of a Bombinator, the operculum still shows the thin area, usually with a small hole, through which the limb would press out if it were there. Is this not a reminiscence of a previously established "mechanomorphosis"? The degeneration of the eyes of cave animals, considered in detail and in connection with Kammerer's experiments on Proteus, point to a hereditary accumulation of the structural results of disuse and darkness. In regard to this and similar cases [illegible] to us to remain a question of interpretation. Which reading of the facts presents least difficulty?

Prof. Semon does not think that we should give up expecting a specific hereditary result of often-repeated injuries, and he refers, for instance, to Kammerer's experiment on the Ascidian, *Ciona intestinalis*, the siphons of which were cut off over and over again. In consequence of the stimulus, the length of the regenerated siphons was excessive, and the uninjured offspring had also excessively elongated siphons. We must, of course, hear more about this interesting case. The sixth chapter marshals the positive evidence which goes to show that parents much modified by peculiarities of nurture may have offspring changed in the same direction, although the peculiar nurture is no longer operative. The evidence includes recent observations on the acclimatisation of plants, Woltereck's experiments on the helmet of Daphnia, and Kammerer's striking work on salamanders and the nurse-frog.

The question then arises: How are the germ-cells affected? Prof. Tower was led by his well-known experiments on potato-beetles to the view that the environmental factors operated on the germ-cells without any induction from the unchanged soma of the parent. But Prof. Semon points out that an adult beetle could not be expected to show much external change, and argues that there is no escape from a theory of somatic induction, the various possible modes of which are carefully and acutely discussed. The author concludes that long-continued functional modifications may by somatic induction exert a specific effect on the germ-cells, and that certain environmental stimuli may also affect the germ-cells by somatic induction. The results depend on three variables: the nature, strength, and duration of the excitations, the general constitution of the organism, and the state of the germ-cells—susceptible or otherwise—at the time. Prof. Semon's latest presentation of the case for the heritability of somatogenic changes is a valuable contribution to ætiology, and one that must be reckoned with by all biologists. The book is written with force and clearness and in admirable scientific temper.

J. A. T.

THE WORK OF G. VON REICHENBACH.

Deutsches Museum Lebensbeschreibungen und Urkunden. Georg von Reichenbach. By Walther v. Dyck. Pp. iii+140+viii plates. (Munich: Deutsches Museum, 1912.)

DURING the last eight or nine years an extremely instructive and valuable collection illustrating the various sections of science and

technology has been accumulated at the Deutsches Museum in Munich, and in 1910 the committee of direction decided to publish a series of biographies of men whose work has had a special bearing on these subjects. The first volume to appear deals with the life and work of Georg von Reichenbach, to whom many advances, not only in the construction of astronomical and surveying instruments, but also in engineering, were due. Born in 1771, his education was carried on not only in school, but also in the workshop with his father, where he showed remarkable mechanical aptitude. At the age of twenty he was sent to England to study mechanical engineering, and in the works of Boulton and Watts in Soho he spent some months working at engine construction. While in England he had not had an opportunity of seeing the works of the leading instrument makers, but availed himself of every opportunity to study this industry also. Ramsden, Troughton, Dollond, Cary and others then supplied the greater part of Europe with instruments of the highest grade, but on his return to Munich he founded workshops for constructing instruments of precision, and for accurately dividing circles.

In the latter part of the eighteenth century a large amount of surveying was done, and in 1801 a base-line 21·7 km. long was measured near Munich for the systematic survey of Bavaria, so that von Reichenbach found his opportunity. The work of Laplace, Gauss, Bessel and others introduced a great increase in the precision aimed at and attained, and Reichenbach successfully constructed theodolites for the Bavarian survey with circles up to twelve inches in diameter; he was acquainted with Ramsden's great 36-in. theodolite which was constructed for General Roy, but apparently preferred the smaller instrument.

Throughout his work Reichenbach adhered to the vernier in preference to the micrometer microscope for astronomical as well as for geodetic instruments on the ground that with the former the portion of the circle was directly measured, while the micrometer measured the enlarged figure of the divisions. The circle of his 12-in. theodolite for the Bavarian survey was divided to five minutes and was read by a vernier to four seconds and by estimation to two. The triangulation of northern Bavaria called for the construction of a base-measuring apparatus, and in 1807 von Reichenbach constructed one consisting of iron 4-metre bars to be placed almost in contact, the interval being measured by a thin graduated wedge.

Large astronomical instruments were also constructed for Naples, Genoa, Turin, Mannheim and elsewhere, and are described as being among the best of that time. A very fine range of instruments, both astronomical and geodetic, is included in the collections of the Deutsches Museum. But, as Gauss remarked in a letter written to Bessel from Munich, the construction of astronomical instruments was not von Reichenbach's principal occupation.

Engineering machinery took up more of his time and attention, and in 1808 he constructed water-pressure pumping engines for the salt-works of Riechenhall and Traunstein, and others of improved design were built, and one of these, at Ilsauk, is still working. Iron-bridge construction and steam-engine design and construction also engaged his attention, and in many spheres of activity von Reichenbach showed remarkable originality and brilliant capacity. His family has presented to the Deutsches Museum a large collection of writings, drawings and plans, which have been extensively utilised in the present monograph, wherein Dr. W. von Dyck has produced not only a highly interesting account of a man of exceptional ability and resource, but has also rendered available a large collection of valuable and important documents relating to the construction of instruments of precision and of machinery, and some of these are reproduced in the plates which illustrate the monograph.

PURE AND APPLIED CHEMISTRY.

(1) *Chemistry of the Oil Industries.* By J. E. Southcombe. Pp. ix + 204. (London: Constable and Company, Ltd., 1913.) Price 7s. 6d.

(2) *Achievements of Chemical Science.* By Dr. J. C. Philip. Pp. vii + 217. (London: Macmillan and Co., Ltd., 1913.) Price 1s. 6d.

(3) *Le Celluloïd et ses Succedanés.* By W. Main. Pp. 162. (Paris: Gauthier-Villars, 1913.) Price 2.50 fr.

(4) *Ausführing qualitativer Analysen.* By Wilhelm Bilz. Pp. xi + 139. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1913.)

(1) THIS work fulfils in a very satisfactory manner the author's attempt "to fill a gap between the elementary text-books of organic chemistry and the numerous technical treatises and monographs of a highly specialised character." The opening chapter on the chemistry of the hydrocarbons and their derivatives will facilitate the reading of later sections by those not very conversant with organic chemistry, but, in the interest of these readers, exception must be taken to the use of the expression "rests," in reference to unsaturated groups or complexes (pp. 14–15). The adoption of this Germanism is quite unwarranted, inasmuch as the idea can

be accurately expressed in ordinary chemical English.

The next chapter contains much interesting matter concerning the origin and chemical nature of mineral oils, and the principles underlying the commercial methods of oil-refining. Under the heading of saponifiable oils and fats a very judicious selection has been made of the most important members of a very large group of substances derived from both animal and vegetable sources. The analytical methods employed in testing these materials are briefly described, and in several instances illustrations are given of the apparatus employed. The industrial applications of fats and oils are classified, special attention being paid to the various commercial processes of hydrolysis, and to the purification of the higher fatty acids by distillation in superheated steam.

In the section devoted to soap and candle manufacture the author shows how the phase rule and recent discoveries in colloid chemistry can be applied to elucidate the reactions of the soap-pan. Reference is also made to the part played by adsorption complexes in the detergent action of soap.

Looking to the future, the production of petroleum motor spirit by the thermal decomposition of heavier hydrocarbons is suggested as a promising problem for research.

(2) The present volume is one of a series of "Readable Books in Natural Knowledge," the author's theme being the usefulness of the chemist to the community. It is to be hoped that this work will assist in dispelling the deplorable ignorance still existing in the minds of many of the British public in regard to the nature and scope of the chemist's activities. Although on the Continent the difference between "chemiker" and "apotheker" or between "chimiste" and "pharmacien" is well understood, in the United Kingdom the chemist is still usually assumed to be a person who of necessity trades behind a window ornamented with large bottles containing various coloured solutions.

After referring to the work of the pioneers of modern chemistry, the subject of combustion is discussed with the object of showing that this typical chemical change includes not only the burning of ordinary combustibles, but also such phenomena as fermentation, the rusting of metals, and the drying of certain oils. In this connection alone the chemist may with advantage be consulted by the farmer, the coal exporter, the cloth manufacturer and other industrial workers in regard to difficulties arising in the ordinary course of their avocations.

The irrational mode of domestic heating with smoky coal leads the author to recommend "coalite" (semi-coke) or gas-fires. A human note is touched by the remark that the latter are regarded with disfavour because they cannot be poked and nothing can be thrown into them. A more serious objection to gas-fires is suggested under the heading of secondary fuels, namely, the grave risk of poisoning arising from faulty gas-fitting and the high percentage of poisonous carbon monoxide present in modern illuminating gas.

The achievements of inorganic synthetic chemistry receive adequate attention. It is pointed out that by a curious coincidence the year 1828 witnessed not only the synthesis of urea, but also the successful manufacture of artificial ultramarine. The natural pigment from lapis lazuli, which was once worth its weight in gold, is now replaced by the synthetic product sold at less than thirty shillings a hundredweight.

The admirable detective work performed by the analytical chemist in bringing to justice the sophisticator of food is noted with the appreciation which this public service deserves.

(3) This volume, which forms one of a comprehensive series of scientific pocket-books, gives a summary of the manufacture of nitrocellulose and its conversion into celluloid by means of camphor and other adjuvants. The inflammability of this material, which is now employed on an enormous scale in the production of cinematograph films, has led to many processes having for their object the preparation of non-inflammable celluloid substitutes. Viscose (an alkaline solution of viscoid) is now manufactured from wood pulp, soda ley, and carbon bisulphide. Acetocellulose, the product of the acetylation of cellulose, has been placed on a commercial basis in the Elberfeld colour works, after seven years of research. Galalite, prepared by precipitating casein with formaldehyde, can be obtained in a transparent condition by first removing mineral salts from the casein by successive treatment with alkalis and acids. The condensation products of phenol and formaldehyde, when indurated to the desired extent by heating under pressure, give rise to the valuable plastic material "baekelite." The work is of interest as showing the extent to which the celluloid industry has developed in France.

(4) Although this guide to qualitative analysis contains a certain amount of useful information, the matter is not arranged in such a way that it can be readily followed. The group reactions, for example, would be more easily grasped if given in tabular form. Very little attempt is

made to furnish theoretical explanations of the various analytical reactions. A few practical details may be quoted as illustrating modern tendencies in laboratory practice. The difficulty of separating nickel and cobalt is overcome by using dimethylglyoxime to precipitate the former metal, whilst the latter is identified in an ethereal extract with ammonium thiocyanate. There is a reversion to an old process in the removal of phosphoric acid from the precipitable metals by means of tin and nitric acid. Absolute alcohol is used to remove calcium nitrate from the mixed nitrates of the alkaline earths. G. T. M.

THE FLOW OF SUBTERRANEAN WATERS.

Le Principe du Mouvement des Eaux Souterraines. By J. Versluys. Traduit du hollandais par F. Dassesse. Pp. 147. (Amsterdam: W. Versluys, 1912.) Price 7 francs.

CALCULATIONS concerning the flow of subterranean water have almost invariably hitherto been based upon the classical law of Darcy, published in 1856—a law which states that the quantity discharged is directly proportional to the head, and inversely proportional to the thickness of the stratum traversed. The terms are simple, and, for general purposes, are sufficiently close approximations to the truth.

It has been demonstrated more than once that the "law" is not absolutely exact, and, in several cases, the divergency from experimental results has been considerable. The law, in fact, has manifest limitations. Darcy omits all reference to temperature, and, indeed, it is doubtful whether he was acquainted with the experiments of Poiseuille, although these had been published ten years earlier, in 1846. The results obtained by Poiseuille led that investigator to conclude that the mean velocity of the fluid depended, in part, on its specific gravity and also on the temperature.

The object of the author of the brochure before us has been to review the situation in the light of recent research, as exemplified by the work of King, Richert, and others. He investigates, in the first instance, the purely theoretical problem of water-flow in its most general form. Then the various numerical results published in the literature of the subject are collated in a form suitable for comparison with the calculated results, and where pronounced divergences occur, observations and explanations are furnished. Finally, for strictly practical purposes, the author gives a series of numerical coefficients for use in cases where merely general approximations will serve.

The book consists of thirteen chapters and is a most painstaking and valuable compilation of the data at present available on the subject.

OUR BOOKSHELF.

Das Relativitätsprinzip. Zweite vermehrte Auflage. By Dr. M. Laue. Pp. xii+272. (Braunschweig: F. Vieweg und Sohn, 1913.) Price 8 marks.

THE second edition of Prof. M. Laue's book on relativity, though on the same plan as the first edition of 1911, contains several additions. In chapter ii. a short discussion of a second arrangement of the Röntgen-Eichenwald experiments is inserted. The kinematic part of the theory of relativity, chapter iii., shows some slight explanatory extensions in § 6, and an enlarged discussion of the inadmissibility of propagation of any physical effects with a velocity exceeding that of light (§ 7). The "cause and effect" point of view here adopted, which leads to a rejection of any hypervelocity of propagation, seems somewhat too narrow. At any rate, it prevented the author from considering the admirable researches on relativistically rigid bodies of M. Born, and especially of Herglotz. In § 8 we remark a fuller exposition and illustration of the notion of "proper time."

In chapter iv. the vector product of two six-vectors and the four-dimensional "Gauss theorem" are inserted. Chapter v. contains, besides a few minor additions, a considerably extended treatment of the theory of the Trouton and Noble experiment, and a much amplified exposition of four-dimensional potential-theory, following the lines of a paper by Sommerfeld. Chap. vi. contains but a few new lines (on pp. 148–164), while vii. (Dynamics) contains many changes and ample additions, viz., Minkowski's dynamics of a point-mass, remarks on the foundations of the dynamics of continuous bodies (§ 27), and the rotational momentum, with a pair of instructive examples, several minor additions in the following paragraphs, and finally the chief addition to the first edition, namely, relativistic hydrodynamics, giving the general equations of motion, and treating the interesting special case of fluids "of smallest compressibility," both essentially on the lines of a paper by Dr. E. Lamla (*Ann. d. Phys.*, vol. xxxvii., p. 772, 1912).

The Dictionary of Entomology. By N. K. Jardine. Pp. ix+259. (London: West, Newman and Co.) Price 6s. net.

THIS useful compilation is a glossary of the technical terms used in describing the structure of insects throughout their several stages. Within the limits which the author has imposed on himself it is likely to be of much service to students of entomology. These limits, it is true, are somewhat narrow; there is no mention of individual species of insects, or of genera or families. The orders, when given, are defined in the briefest possible manner, and frequently there is no indication of the insects comprised in them. The words "Coleoptera" and "Lepidoptera" find a place, but there is no mention of Dermaptera, Odonata, Homoptera, or Heteroptera. Hemiptera and Neuroptera are given, but beyond a bare defini-

tion there is nothing to show their content. Some of the terms used in insect bionomics might have been included without greatly adding to the bulk of the work; these are not exclusively applicable to insects, but it is in entomological literature that they are chiefly to be met with. It might also have been well to add references in the case of the less usual terms.

The derivations will be welcomed by many; they are sometimes omitted, as under "coenogonous." Two incompatible derivations are given for 'caterpillar," but the author does not help us to lecide between them. A few misprints may be ıoted; "carneous" for "corneous," under cranium"; "unbra" for "umbra"; "tergum," nder "anal angle," probably for "termen," ıough the latter is insufficiently explained. Other ips occur, but on the whole the book is well ıited for its purpose.

LETTERS TO THE EDITOR.

'he Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Antarctic Barometric Pressure.

THE reduction of the barometric readings taken ring the first year of Capt. Scott's Antarctic expedi-n has shown what I imagine to be an unprecedented e of barometer from one month to the next. The ᵢan barometer during November was higher than ring October by 0·81 in. at Cape Evans, 0·80 in. at pe Adare, and 0·87 in. at the Norwegian winter arters. The rise continued into the next month, d the mean value at all three stations for December s approximately one inch higher than that for tober.

The instability of the atmosphere shown by such a ınge has a melancholy interest in view of the sad aster caused by the weather, and is further of great teorological importance. I should therefore be teful for any information of similar large changes, that they may be considered in my discussion of meteorological results of the expedition.

'he following table gives the mean height of the ometer at the three stations. The data have been uced to sea-level and normal temperature and vity. The large difference between the mean ıes at Framheim and Cape Evans is being inves-ıted.

	Framheim	Cape Evans	Cape Ad
ıt.	78° 38′ S.	77° 35′ S.	73° 27′ S
ıng.	195° 30′ E.	166° 33′ E.	170° 15′ E
1911			
bruary ...	—	29·31	—
arch	—	29·21	29·12
ril	29·08	29·32	29·25
... ...	29·02	29·23	29·05
ne	28·88	29·11	29·11
ly	28·86	29·08	29.01
ıgust ...	28·94	29·19	29·06
ptember ...	28·90	29·16	28·98
tober ...	28·61	28·82	28·76
ıvember ...	29·49	29·63	29·56
cember ...	29·66	29·75	29·72
1912			
ıuary ...	29·36	29·43	—

GEORGE C. SIMPSON.

mla, March 20.

X-Ray Spectra.

WE have recently been carrying out some experiments with the object of finding whether spectra of heterogeneous beams of X-rays can be obtained by letting the rays fall on a crystal surface which would serve as a diffraction grating.

A beam of rays from a Röntgen bulb was directed on to the cleavage surface of a crystal of selenite at almost grazing incidence, the beam being made practically parallel by means of suitable lead stops. All the photographs taken of the reflected beam show exceedingly well-defined lines, which are not equally spaced, their number and distances apart varying according to the particular bulb used. These lines are parallel to each other and to the slit. The hardness of the bulb affects the relative intensity of the lines, but apparently makes no difference to their relative positions. Using the same bulb, crystals of different thicknesses all give the same lines.

The accompanying figure represents diagrammatically the lines obtained in one of the photographs. The direct beam strikes the plate at x, and in the reflected beam are seen three well-defined lines, x_1, x_2, and x_3 (in addition to what appear to be interference bands, not shown in the figure). When the bulb was

soft the line x_1 was very intense, whilst the other two lines were comparatively faint. Another photograph taken with the same bulb after it had been hardened shows the line x_1 very much less intense than formerly, whilst the lines x_2 and x_3 have increased in intensity. It appears, therefore, that the line x_1 is due to the softer constituents of the beam, and the lines x_2 and x_3 are due to the harder constituents. That is to say, the rays of longer wave-length are less deviated than the rays of shorter wave-length.

The results suggest that the lines obtained may be spectral lines in the spectra of the beams emitted from the respective bulbs. Further experiments are being carried on.

E. A. OWEN.
G. G. BLAKE.

Teddington, Middlesex, April 7.

X-Rays and Crystals.

ON repeating the experiments of Laue, Friedrichs, and Knipping on the transmission of X-rays through crystals, I have found that the transmitted rays may easily be made visible by means of an ordinary fluorescent screen, if we use a sufficiently large pencil of rays, and the crystals are sufficiently transparent to the incident ray.

The X-ray tube used was a Müller-tube of 20 cm. diameter, with water-cooling; the current was supplied by a Toepler influence machine with sixty plates. The diameter of the pencil of rays was 0·5–1·0 cm. The crystals examined were borax, alum, mica, fluorspar, rock-salt, rock-crystal, cane-sugar, &c., the thickness varying from 4 mm. to 1 cm. The transmitted rays show numerous detached fluorescent spots of elongated shape. If we rotate the crystal about an axis perpendicular to the incident ray, the spots move generally across the central spot caused by the incident ray, but we may choose the axis of rotation such that some of these spots remain stationary while the crystal is rotated.

Groups of detached pencils are arranged, as it were,

on circular cones, which always touch the incident pencil, and the aperture of which varies continuously with the inclination of the crystal. With a plate of mica, a spot was observed which is situated as if it were the reflected image of the incident ray; but it is doubtful whether we may call it "reflected," because other spots are also seen on the same side of the plate, deviating considerably from the "image." Further experiments in this direction are in progress.

T. TERADA.

Physical Institute, Imperial University, Tokyo, March 18.

Fish-eating Habits of a Spider.

IN a lecture delivered to the Natal Scientific Society on November 22, 1911, the Rev. N. Abraham dedescribed the habits of a spider that he had observed catching and eating fishes. An account of the lecture was printed in *The Natal Advertiser* and subsequently reprinted in *The Agricultural Journal of the Union of South Africa*, but, so far as I am aware, these interesting observations have not appeared in any prominent scientific publication.

When Mr. Abraham's lecture was given the spiders had not been determined, but I have since had an opportunity of examining two preserved examples in his possession, and I have determined them as *Thalassius spenceri*, Picard-Cambridge (Proceedings of the Zoological Society, 1898, p. 28).

The following is an extract from the newspaper account:—"In the year 1905 I was living in Greytown, Natal. One day I was catching small fish and aquatic insects for an aquarium. I was using a small net in a shallow stream. I happened to see on the edge of the water a fine spider, which I captured. On reaching home I placed my specimen in a large aquarium, where I had a number of small fish. The spider measured about three inches when its legs were extended; the body is small, but the legs are long. After being on the rockwork of the aquarium for some time, it took up a very interesting position. It rested two legs on a stone, the other six rested on the water, well spread out, the ends of the six legs commanding a definite and well-defined area of water.

"Being busy, I merely took a note of its attitude, and left it to its devices. After a few minutes my servant boy came into my study to say that the spider I had put into the aquarium was eating one of my pet fish. I at once went to see what had happened, and soon saw the spider on top of the rockwork, holding in its grip a beautiful little fish about four times the weight of its captor. For a moment I was startled into a strange surprise. How could this spider, which has no power to swim, catch a lively, quick-swimming fish? I looked at it in wonder, as it seemed to clutch the fish as a cat clutches a mouse. It soon began to devour its catch, and after some time had passed nothing was left of the fish but its backbone. The spider had eaten it as surely as an otter eats its trout.

"I was now anxious to find out how the spider caught the fish. That night, about 11 o'clock, when I had finished my day's work, I sat down by the aquarium to watch the spider, with the hope that I might see how the fisherman caught his fish. The spider had taken up a position on a piece of stone, where the water was not deep, and had thrown out its long legs over the water, upon which their extremities rested, making little depressions on the surface, but not breaking the 'water skin.' The tarsi of two posterior legs firmly held on to a piece of rock just above water-level, the whole of the body was well over the water, the head being in about the centre of the cordon of legs, and very near to the surface of the water.

"After watching for some little time, I saw a small fish swim towards the stone and pass under the outstretched legs of the spider. The spider made a swift and sudden plunge. Its long legs, head, and body went entirely under the water, the legs were thrown round the fish with wonderful rapidity, and in a moment the powerful fangs were piercing the body of the fish. The spider at once brought its catch to the rocks, and began without delay to eat it. Slowly, but surely, the fish began to disappear, and after the lapse of some time the repast was over."

Recently the Rev. Father Pascalis Boneberg, of the Marianhill Monastery, Natal, has added to Mr. Abraham's observations. Father Boneberg has seen examples of this same spider catching and devouring tadpoles of the toad *Bufo carens*, and adults of the little frog *Rappia marmorata*. It is his intention, I understand, to communicate an account of his observations to a German scientific publication shortly.

That the observations of both these gentlemen are based upon the same species, *Thalassius spenceri*, I have no doubt, for Father Boneberg allowed me to examine an adult male and female, and two immature examples, of his spider. The two latter specimens he kindly presented to the Durban Museum.

E. C. CHUBB.

Durban Museum, Natal, March 15.

A Detonating Daylight Fireball.

THE following may be of interest to some of your readers. On the morning of February 10, at about 6 a.m., the manager and some of the employees of a sheep farm which is situated on the Coyle River, about seventy miles from its mouth, were working close to the settlement when they were suddenly startled by an almost deafening noise which resembled the explosion of a huge gun or a violent peal of thunder close at hand. This was followed by a humming sound, such as would be produced by a motor-car, which lasted for about twenty seconds, after which interval there was another explosion, less violent than the first, which in turn was followed by further hummings and explosions, the latter gradually dying away in about a minute or so.

These men saw nothing to account for the sound, but as the settlement is situated at the foot of a high hill, which rises to the south, it was their impression that the noise came from over the top of this hill. Later in the day Mr. Welsh, the manager referred to, from whom I had most of the facts, met some carters, who told him that they actually saw the object, that it was about twenty-five miles further down along the same river on the top of the high pampa at the same hour, that it resembled a huge ball of fire with a long tail behind, and passed rapidly from east to west; they noticed no explosion.

These facts were corroborated by a sheep farmer (Mr. Ness), who lives about twenty-eight miles above Mr. Welsh, on the same river. Mr. Ness told me that he did not see the object, but that the sound of the explosion shook all the windows in his house and was followed by the same humming sound and secondary shocks.

The servant of a neighbour in this town also informs me that on the same morning at about the same hour she heard what she considered a series of bombs exploding. Now Mr. Ness's house is upwards of ninety miles from here, and as it shook his windows it would probably have been heard another sixty miles further on; this would lead one to believe that the explosions were distinctly audible over an area

of at least 150 miles in diameter, and were no doubt produced by a huge exploding fireball. The morning in question was clear and bright. E. G. FENTON.

Rio Gallegos, Patagonia, February 12.

On the Gain of Definition obtained by Moving a Telescope.

Is not the case mentioned by M. E. J. Gheury in NATURE of Marc[illegible] (p. 86) but a special case of the familiar fact that an object which is so like its background as to be invisible when at rest is commonly visible when it moves? In this case, as the telescope moved, the signal in its field of view was to the eye fixed to its eyepiece an object moving against the background of misty sky, which it so nearly resembled as to be invisible when at rest. Is not the explanation as follows? Visibility of the object, and in particular of its outline, depends on *contrast* between it and its background. There is commonly *some* contrast, but often so slight as not to attract attention when the object is at rest. When, however, the object moves, the brain receives successive impressions of contrast as the image of the object falls on one part of the retina after another. Thus the brain receives a *cumulative impression of contrast* between the object and the background, and the object becomes "visible."

If this be not, as perhaps it is not, a perfect explanation of this familiar fact, there are probably many others beside myself who will be glad to know what the correct explanation is.

Candahar, Reigate. G. W. BUTLER.

NORTHERN METHODS OF BURIAL IN THE IRON AGE.

MR. SCHETELIG'S excellent memoir[1] describes the recent more precise investigations which correct and elucidate older work. Relics other than from graves are insignificant, and the nominal restriction to Vestland scarcely lessens the interest, for local discoveries are throughout compared with those in other provinces and countries. Neither a *catalogue raisonné* of antiquities, nor a general account of the evolution of Norwegian culture during the Iron Age, the volume serves as a foundation for works of those two different classes. The objective account of the graves themselves, and of the disposition therein of the varied remains, is its endeavour; and its general conclusions relate mainly to the development of burial methods.

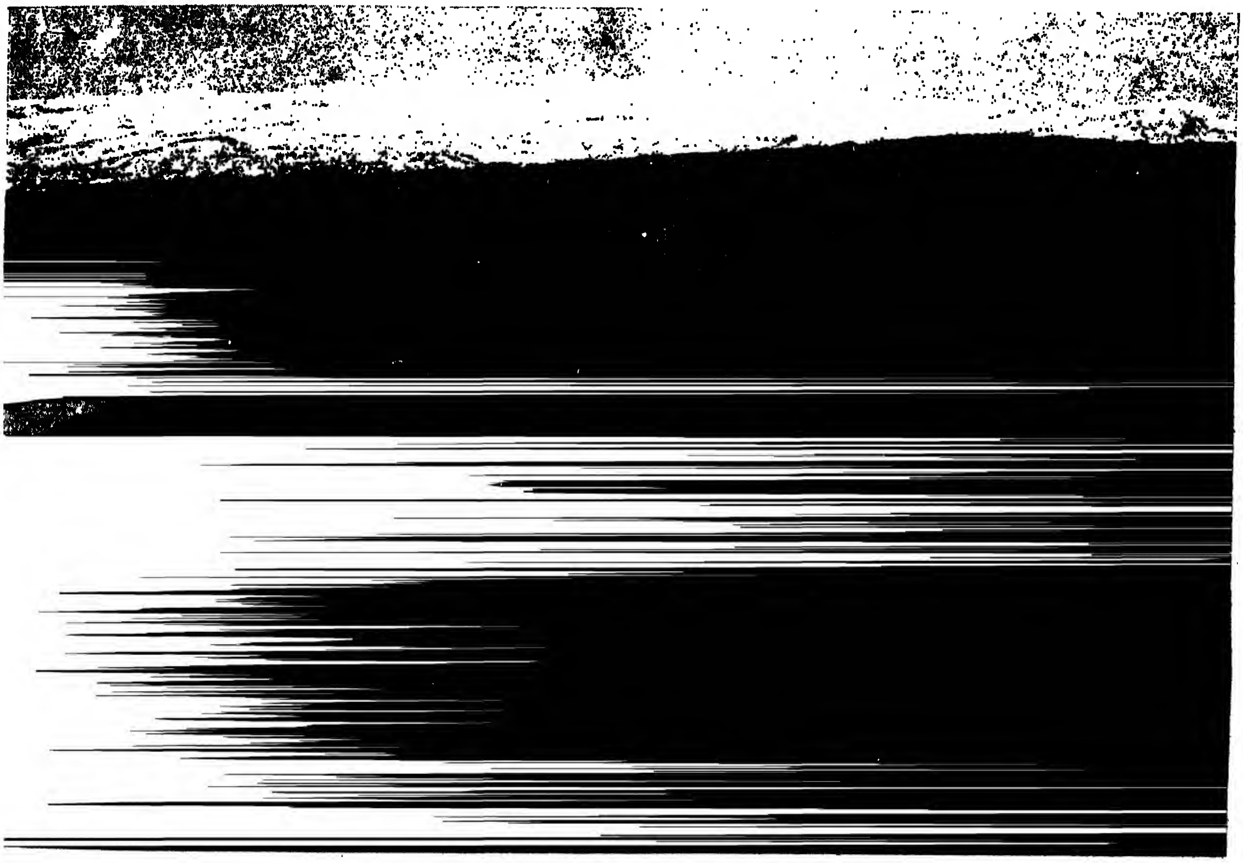

FIG. 1.—The Byrkje grave-mound at the beginning of the excavation. From "Vestlandske Graver fra Jernalderen." Bergens Museums Skrifter.

The third and fourth centuries A.D. are, in Vestland as elsewhere, those most influenced by Roman culture, while during the fifth and sixth centuries more original lines were followed. During the third century, however, a greater change occurred than about the year 400; it was

[1] "Bergens Museums Skrifter." Ny Raekke. Bd. ii. No. 1. Vestlandske Graver fra Jernalderen. By Haakon Schetelig. Pp. iii+242. (Bergen: A/S John Griegs Boktrykkeri, 1912.)

also before the latter date that Vestland entered into relations with the West Germanic civilisation on the east coast of the North Sea, and the Anglo-Saxon on its west coast.

Burials without cremation first occurred in the northern countries during the Roman period, and with a broadening of culture the funeral furniture grew more elaborate and diverse. These changes, entering Vestland later than other parts of Scandinavia, affected also the cremation burials, and in the Folk-wandering period (400–800 A.D.) the two kinds tended to fuse. Thus both methods occur in a grave-mound with three graves at Byrkje in Voss (Fig. 1). One of these graves, that of a woman, is further noteworthy as the oldest boat burial in Norway, and approximately contemporary with the sixth-century boat grave in Suffolk. This mode of burial seems to have been the logical outcome of the Charon belief, evidences of which are found about this time in the form of ferry money. Rooting itself naturally and growing exuberantly in the mind of a seafaring folk, this rite bore its richest fruit in the subsequent Viking period, when the gross materialisation of a more primitive symbolism reached its climax. Towards that period there are also observed an increase in the number of weapons, a decrease in the size of the mounds, and a tendency to uniformity of style throughout the whole of the north.

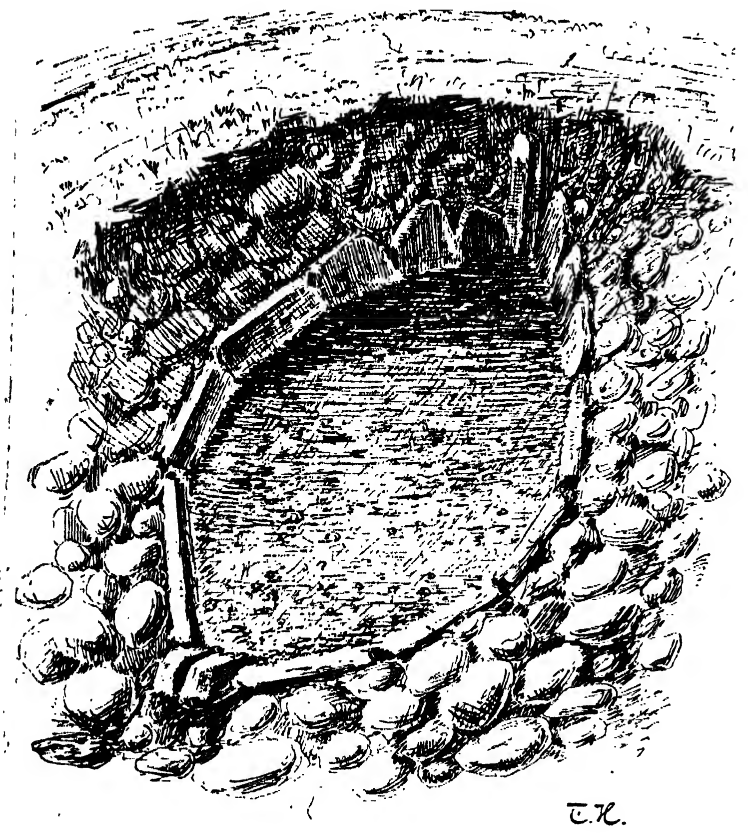

FIG. 2.—A boat-shaped arrangement of stones round a cremation-burial at Ølbør; a wooden boat also formed part of the pyre. (After T. Helliesen, Stavanger Mus. Aarsh., 1902). From "Vestlandske Graver fra Jernalderen." Bergens Museums Skrifter.

Usually in the Viking period there was a funeral pyre on a flat surface, below which the grave was dug and afterwards filled in with large stones, while its position might be marked by one or more gravestones (Fig. 2). The older orientation of head to north was often departed from. This last change and the increased simplicity may betoken Christian customs, if not actually Christian faith. But the halls of the mighty were still homes of heathen worship; their bodies lay when dead with head true to the north of their fathers, and over them, as at Upsala, at Tune, or at Gunnarshaug, were piled the highest mounds with the richest store of goods and the hugest sacrifices known from all Scandinavia.

MIGRATIONS OF BIRDS.[1]

THE volume before us is the seventh of the series of annual reports on migration which we owe to the industry of a committee of the British Ornithologists' Club, which has set itself the task of collecting evidence over a period of ten years, and thereafter of summarising the data thus obtained. The reports have increased progressively both in scope and bulk, and the one before us is a stout volume. It deals mainly with the immigratory movements of birds visiting England and Wales for the purpose of nesting in the summer of 1911. Passage movements are also dealt with, and the autumn movements of 1910 as reported by lighthouses and light-vessels. Summaries of the meteorological conditions are furnished for purposes of comparison.

As the drawing of conclusions is forbidden by the self-denying ordinance of the committee, the volume before us is to be regarded as a summation of facts, and as such it deserves all praise, for everything possible has been done to ensure clearness by condensation, tabulation, and the addition of diagrammatic tables. An immense amount of material has had to be classified and arranged, and we think that the committee has chosen the best course in grouping its facts under the headings of species, although the initial chronological summary is perhaps the most interesting to the casual reader.

The spring migration commenced on March 16 and continued until May 29. During the latter half of April there were three distinct waves of

[1] Report on the Immigrations of Summer Residents in the Spring of 1911; also Notes on the Migratory Movements and Records received from Lighthouses and Light-vessels during the Autumn of 1910. By the Committee appointed by the British Ornithologists' Club. Published as vol. xxx. of the Bulletin of the British Ornithologists' Club. Edited by W. R. Ogilvie-Grant. Pp. 332+20 maps. (London: Witherby and Co., 1912.) Price 6s.

migration—on April 17 and 18, 23, 27 and 28—each of increasing intensity. There was another large influx on May 5. The immigrations of the willow-warbler (probably two races), which lasted from March 11 to May 6, and of the wheatear (two races), from March 19 to May 10, covered the longest period among the species recorded; while those of the wood-warbler between April 16 and May 13 occupied the shortest time. Notice is drawn to the increasing and now extreme scarcity of the landrail in the south-east of England.

The records which are of most interest merely in themselves are perhaps those to be found in the section dealing with the autumn movements. The autumn of 1910 was noteworthy for the large influx of certain northern species, such as the waxwing, northern bullfinch, mealy redpoll, and continental great tits. Jays were recorded as migrants to the south-east of England, and with them magpies (a flock of twenty), the latter being thus for the first time recorded as migrants to our shores. Great numbers of the little golden-crested wren were on the move round all our coasts between the end of August and mid-November.

LONDON WELLS.[1]

HOW complex and how serious is the problem of maintaining a supply of water suitable to its needs few of the inhabitants of London have any conception. We turn the tap for our morning tub or to fill the kettle for tea and would be surprised and annoyed if the water did not readily flow. During the past few years, however, many large users of water have turned their attention to the provision of private supplies and the number of wells has greatly increased. The early wells of the city and surrounding area were dug in the superficial gravels and Tertiary formations alone, for in those days they yielded a satisfactory supply without the need of descending further; gradually these shallow wells produced a smaller volume and a deteriorating quality of water, and had to be deepened and sunk into the Chalk.

According to the researches of Mr. A. S. Foord, there were no deep wells either in or near the city till at least the middle of the eighteenth century. It is probable that the difficulty of dealing with the mobile Thanet Sands delayed the introduction of deep wells until the art of overcoming the trouble had been perfected. The yield of many of the older wells was increased by putting a boring at the bottom. Now, the practice of sinking shafts is almost abandoned in favour of boring alone. These borings are lined in the upper portion and are carried as far as necessary into the Chalk. This change has been brought about by the fact that borings are cheaper than dug wells, and that the latter would have to be sunk at least 100 ft. before any water could be reached.

The height of the water level in London wells has been sinking for a long time, but in recent years the fall has been increasingly rapid. This is most clearly brought out in the memoir before us by maps showing the contours of the underground water-surface and by the data supplied with many of the well records. The lowering of the water-level, if continued at the present rate, must seriously affect all wells in the London area, not only as regards quantity, but also quite possibly with respect to quality also. Mr. Barrow has great faith in a remedy for this evil, one which has already proved effective in the hands of Mr. W. B. Bryan in maintaining the level in the waterworks district at Lea Bridge. He recommends that spare water should be conserved in reservoirs in suitable districts and poured as required into dumb wells sunk into the Thanet sand, whence it would permeate into the Chalk; in the introduction to the memoir he brings forward a good deal of evidence in support of this method.

The influence of the Tertiary cover on the quality of the water drawn from the Chalk is remarkable. Water taken from the Chalk beyond the Tertiary outcrop carries a preponderance of lime salts; that from the Chalk beneath the Tertiary is much poorer in lime, which the sodium salts have greatly increased. This change is usually attributed to the influence of the Thanet sand. Dr. Thresh's valuable experiments on the effects of this sand are briefly discussed; but this is a subject of great complexity and requires further study. The work on soils carried out by various agronomic surveys, and that of Cushman and others on the influences of colloids in clays, should have some bearing on the problem.

The well records in this volume are very numerous, and many are published for the first time. They should prove of the utmost value gathered together in this form. Only by complete and accurate records and their careful correlation with geological conditions can an outlook be obtained on the state of the underground water as a whole. If the recording of all borings for water in the United Kingdom were made compulsory, much unnecessary waste would be avoided.

[1] Memoir of the Geological Survey, England and Wales. Records of London Wells, by G. Barrow and L. J. Wills. (H.M. Stationery Office, 1913.) Price 4*s*. 6*d*.

THE LISTER MEMORIAL FUND.

WE are informed that the contributions recently made to the Lister Memorial Fund include the following: Clothworkers' Company, 100*l*.; Grocers' Company, 52*l*. 10*s*.; Ironmongers' Company, 25*l*.; Mercers' Company, 105*l*.; Merchant Taylors' Company, 262*l*. 10*s*.; Skinners' Company, 105*l*.; Society of Apothecaries, 52*l*. 10*s*.; Corporation of the City of Glasgow, 52*l*. 10*s*.; Royal College of Physicians, 21*l*.; Royal College of Surgeons, 52*l*. 10*s*.; Royal Dublin Society, 50*l*.; Royal Horticultural Society, 52*l*. 10*s*.; the Royal Society, 50*l*.; Harveian Society, 10*l*. 10*s*.; Pharmaceutical Society, 10*l*. 10*s*.; Physiological Society, 10*l*. 10*s*.; Royal Microscopical Society, 5*l*. 5*s*.; Royal Sanitary Institute, 5*l*. 5*s*.; the

Manchester Cooperative Wholesale Society, 21l., and many medical societies. Lord Strathcona has

committees for the purpose of collecting subscriptions have been formed by the Universities of Oxford, Cambridge, and Durham, and other universities are also making efforts locally to promote the success of the memorial. Arrangements have also been made for the formation of committees in the British Dominions beyond the seas and in foreign countries.

The proposed memorial will be of a threefold character, and consists of (1) a simple marble medallion bearing a sculptured portrait of Lord Lister, to be placed in Westminster Abbey among the monuments of the nation's illustrious dead; (2) a larger and more conspicuous monument, to be erected in some public place in London, and (3) the founding of an International Memorial Fund, from which either grants in aid of researches bearing on surgery or rewards in recognition of important contributions to surgical science will be made, irrespective of nationality. A considerable sum of money is required to carry out these proposals. Donations should be sent to the treasurers of the fund at the Royal Society, Burlington House, London, W.

NOTES.

SIR OLIVER LODGE has been elected president of the British Association, in succession to the late Sir William White, for the meeting to be held in Birmingham next September.

THE Lord Mayor has given permission for the annual meeting of the British Science Guild to be held at the Mansion House on Wednesday, May 21, at 4 p.m., when he will preside, and Sir William Mather, P.C. (Lord Haldane's successor to the presidentship), will be present. The annual dinner of the guild will be held on Monday, May 26, at the Trocadero Restaurant. The guild has recently been considering the important question of pure milk and the Government Milk Bill, and has drawn up a report in connection with it. A report has also been prepared on national education, and it will be presented to the Government in connection with the contemplated organisation of our educational system.

LORD BURGHCLERE, chairman of the Royal Commission on Historical Monuments, Sir Thomas R. Fraser, F.R.S., professor of materia medica and clinical medicine, University of Edinburgh, and Mr. E. H. Tennyson-D'Eyncourt, Director of Naval Construction, Admiralty, have been elected members of the Athenæum Club, under the provisions of the rule of the club which empowers the annual election by the committee of a certain number of persons of "distinguished eminence in science, literature, the arts, or for public services."

THE death is announced, on April 7, at sixty-nine years of age, of Mr. F. G. Smart, fellow of the Linnean and the Royal Geographical Societies.

MR. G. C. CURTIS is starting for Hawaii in order to carry out a commission to construct for the geological museum at Harvard a relief model of the volcano Kilauea.

PROF. IRA N. HOLLIS, who has been head of the department of engineering at Harv[illegible]ce 1893, has resigned his chair in order to acce[illegible]he presidency of the Polytechnic Institute, Worcester, Mass.

THE death is announced, in his seventy-sixth year, of Prof. H. Alexan Bezjian, teacher of physical science in the Central Turkey College, Aintab, Turkey-in-Asia, and described by *The Times* as "one of the most distinguished scientific men that Turkey has yet produced."

THE medical faculty of the University of Birmingham has suffered a severe loss by the sudden death of Prof. Jordan Lloyd, who had been a member of the University staff since the foundation of the University, having previously occupied the chair of surgery at Mason College since 1891.

THE summer meeting of the Institution of Mechanical Engineers will be held in Cambridge, and will begin on Monday, July 28. On the following day the Vice-Chancellor of the University, the Mayor of Cambridge, and the members of the local committee will receive and welcome the president, Sir H. Frederick Donaldson, K.C.B., and the council and members of the institution, in the Senate House of the University. Papers will be read and discussed on that and succeeding days, and there will be visits to engineering works, laboratories, and places of interest in Cambridge, as well as various social functions.

ON Tuesday next, April 15, at three o'clock, Prof. W. Bateson will deliver the first of two lectures at the Royal Institution on the heredity of sex and some cognate problems, in continuation of those delivered before Easter, and on Thursday, April 17, Prof. J. Garstang will begin a course of three lectures on the progress of Hittite studies. The Friday evening discourse on April 18 will be delivered by Dr. T. M. Lowry on applications of polarised light, on April 25 by Prof. J. Garstang on Meroë: four years' excavations of the ancient Ethiopian capital, and on May 2 by Mr. H. G. Plimmer on blood parasites.

A JOINT meeting of the Institution of Electrical Engineers and the Société Internationale des Electriciens will be held in Paris on May 21–24. The inaugural meeting on Wednesday, May 21, will be held at the Conservatoire des Arts et Métiers. The programme includes papers and discussions on the electrification of railways; long-distance transmission of electrical energy; lighting by means of vapour-tube lamps; and wireless telegraphy. There will be a reception and banquet at the Palais d'Orsay by invitation of the Société Internationale des Electriciens; a kinematograph demonstration by M. Gaumont; visit to the aërodynamical laboratory of M. Eiffel at Auteuil; reception by M. Eiffel at the highest platform of the Eiffel Tower, and inspection of the wireless installation, as well as many other social functions.

The annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 1–2. At the opening session the Bessemer gold medal for 1913 will be presented to Mr. A. Greiner, and on May 2 the Andrew Carnegie gold medal (for 1912) will be presented to Dr. J. Newton Friend, and the awards of research scholarships for the current year will be announced. Among the papers that are expected to be submitted are the following:—"Critical Ranges of Pure Iron, with Special Reference to the Point A_2," Dr. H. C. H. Carpenter; "Influence of the Metalloids on the Properties of Cast Iron," H. I. Coe; "Influence of Silicon on the Corrosion of Cast Iron," Dr. J. Newton Friend and C. W. Marshall; "Studies in the Cold Flow of Steel," P. Longmuir; and "Production of Sound Steel by Lateral Compression of the Ingot whilst its Centre is Liquid," B. Talbot.

We have received the prospectus of an International Ornithological, Entomological, and Botanical Exhibition, to illustrate the economic aspects of ornithology, which is to be held from May 3 to June 1 in the Palais des Beaux-Arts at Liége, under the auspices of three Belgian ornithological societies. The exhibition will be essentially "documentaire," that is to say, based on treatises devoted to the economic aspects of ornithology, and its connections with entomology, but it will also include collections of birds, insects, and such plants as furnish, in the shape of their seeds, a large proportion of the food of birds. To render the show more attractive to the general public, collections of butterflies will be admitted. The object of the exhibition is stated to be entirely for the advancement of science, and not for profit. Exhibits are invited, and intending exhibitors requested to send their communications to L. Cuisinier, 155 Rue de Bruxelles, Ans.

The death is announced, on April 6, at sixty-three years of age, of Prof. Adolf C. H. Slaby, inventor with Count Arco of the German system of wireless telegraphy. He had a stroke of paralysis about two years ago, and was obliged to retire from the Charlottenburg Hochschule, of which he was at various periods director. A fortnight ago he had a second stroke, and never recovered consciousness. We are indebted to *The Times* for the following particulars of his career:—Prof. Slaby was from 1884 to 1902 director of the electrical laboratory at the Technische Hochscule, and there began the experiments which led to the perfection of the "Telefunken" system. From the Emperor William, who made his acquaintance when the White Hall of the Royal castle in Berlin was fitted with electric light and gave him frequent encouragement and support, he obtained permission to use the Royal gardens on the banks of the Havel for his experiments. Here he worked the whole of the summer of 1897, sometimes ten hours a day, attempting to establish wireless communication between the Pfauen island in Wannsee and the Pfingstberg. In October of that year he established wireless connection between two captive balloons at a distance of 21 kilometres. The range of the German wireless system, of which Siemens Telefunken Company has acquired the monopoly rights for Great Britain, is now said to be 6000 kilometres.

It is gratifying to learn that the Gypsy Lore Society is now in a flourishing condition, though the number of members is still smaller than it should be. In the second part of vol. vi. of the society's Proceedings Mr. H. L. Williams, of the Indian Police, continues his interesting notes on the criminal and wandering tribes of India. He quotes a current rumour that some of these people in the Punjab and United Provinces of Agra and Oudh are anthropophagous. Two supposed informers are said to have been killed and eaten in a Sánsi camp in the Bhartpur State. The story, as it is recorded, is almost incredible, and seems to be only an instance of the facility with which the settled people in the northern plains are accustomed to accept all kinds of marvellous tales regarding these uncanny and mysterious vagrants.

The Journal of the Royal Anthropological Institute, of which the final part of vol. xlii. has recently been issued, forms a valuable record of the excellent work in physical anthropology, ethnography, prehistoric archæology, and linguistics which the institute, under its present management, is prosecuting. In its *format* and in the abundant illustrations with which it is furnished, it is equal, or perhaps superior, to the publications of any European society which covers the same field of research. It is scarcely creditable to the Empire that work of this kind does not receive more adequate recognition. In any other country possessing opportunities for the study of anthropology a society like this would be supported by a State grant, and would bear on its rolls a much larger number of subscribers. Funds are urgently required for extending its work. In particular, *Man*, the monthly journal of the institute, does not provide adequate space for a record of current literature, and for the publication of short notes or articles of anthropological interest. The institute is most uncomfortably housed, and its library needs extension and better arrangement before it can meet the wants of students. It may be hoped that when the condition of this important branch of research is brought to public notice the institute may meet with adequate support from the State, from students in this country, and from the large body of English officers working among savage races throughout the Empire.

We have before us the first part of a new text-book of physiological histology, by Prof. Sigmund, of Teschen, which is being translated into English by Mr. Lovatt Evans, of University College, London. Carl Zeiss, Ltd., is the London firm responsible for the issue. It is beautifully illustrated, and the descriptive text is admirably lucid and up-to-date. The special feature of the work, however, is that it is accompanied by actual microscopical specimens. Thus part i., which deals with the skin, has with it ten specimens to illustrate the structure of the cutaneous organs. We have nothing but praise for the specimens, and these will be highly prized by those who have not the time or opportunity of making microscopic slides for themselves, but nevertheless desire to examine such specimens. We would, however, caution students that pictures, however beautiful, and bought slides, however perfect they may be,

can never really teach them histology. The specimens they prepare themselves may not exhibit the same technique, the rough drawings they themselves execute may not be highly artistic, but the educational value of such far transcends that of purchased specimens or highly coloured diagrams.

We have received from Messrs. Charles Griffin the first number of the sixth volume of *The Quarterly Journal of Experimental Physiology,* which was brought out under the editorship of Prof. Schäfer five years ago. When this new periodical first appeared doubt was expressed in some quarters whether there was room for a new physiological journal. But nothing succeeds like success, and we heartily congratulate its distinguished editor on having justified his expectations in relation to the life and vigour of the journal. The present number contains a noteworthy paper by Prof. Herring on the comparative anatomy and physiology of the pituitary body, a subject which he has made his own; Prof. Schäfer and Mr. Gavin contribute articles on one of the functions of this remarkable gland, namely its influence on the secretion of milk. Dr. Graham Brown continues his studies on the physiology of reflex action. Drs. Cramer and Pringle deal with the much-vexed question of blood-coagulation, pointing out the importance of the platelets in the process, and, finally, Mr. Miller, of Montreal, treats of the nerve centres concerned in the secretion of saliva, and Dr. Grube, of Kansas, on the blocking of nerve impulses. The journal thus deals with many important aspects of physiological progress, and should be on the bookshelves of all working physiologists and others interested in the subject.

Parts i. and ii. of the ninth volume of *Biometrika* are given up mainly to the consideration of statistical methods. Thus 150 pages are occupied by an article of Prof. Karl Pearson's and Dr. David Heron's on theories of association, which would be more interesting and valuable if it were not merely one stage in a controversy between the authors and Mr. Yule. Four papers treat of methods for obtaining the "probable error" of statistical constants of various kinds, and one on the influence of "broad categories" on correlation. Among those contributions which deal rather with practical results than with statistical theory is a study by Mr. A. B. Emmons, of Harvard, on variations in the pelvis of American Indian squaws. His observations are in conformity with the statement of Engelman that labour is as a rule short and easy among North American Indians who marry within their tribe. He finds that in almost three-quarters of the specimens examined the dimensions of the pelvis would have allowed an easy delivery where the head of the fœtus was about the normal size. Another paper dealing with a subject of considerable importance is that of Mr. E. C. Snow on the intensity of natural selection in man. This is a supplement to his original memoir, which has already been noticed in Nature.

The January issue of *Science Progress* (No. 27, 1913) contains an article by Dr. R. R. Armstrong on the mechanism of infection in tuberculosis. Dr. Armstrong expresses the opinion that infection of children from tuberculous milk is of minor importance, and that in their case, as with adults, infection is mainly with the human type of tubercle bacillus by way of the respiratory tract.

A pamphlet on the house-fly as a danger to health: its life-history and how to deal with [illegible] Mr. Ernest Austen, has been issued by the trus[illegible] the British Museum at the price of 1*d*. It gives in simple language the life-history of the house-fly and describes its breeding habits and its dangers to health. The pamphlet is illustrated with two full-page half-tone plates of the house-fly and lesser house-fly and of the house-fly maggots.

We have received a small volume entitled "Anleitung zur Kultur der Mikroorganismen," by Dr. Ernst Küster (B. G. Teubner, second edition, 1913). It contains a very complete account of the methods and media employed for the cultivation of the protozoa, bacteria, myxomycetes, algæ, and fungi. The matter has been brought well up to date, including, for instance, the work of Bass on the cultivation of the malaria parasite. The price is 8 marks.

To the March number of *The Zoologist* Prof. Stanley Gardiner contributes a highly appreciative and sympathetic memoir of the late Prof. Adam Sedgwick, with special reference to his early work and associates at Cambridge, and the gradual building up of the modern school of morphology at that University.

In the *Boletin de la Sociedad Physis,* vol. i., No. 3, Mr. A. Gallardo gives an account of a plague of ants which made their appearance in certain parts of the province of Buenos Aires during 1904–5. The species is the so-called Argentine or New Orleans ant, *Irodomyrmex humilis,* an exceedingly prolific insect, of which colonies have made their appearance during the present century in New Orleans, Madeira, Portugal, and elsewhere. In the opinion of the author this aggressively colonising ant is probably an immigrant into Buenos Aires, and its real home some part of tropical America.

To the Smithsonian Institution we are indebted for a notice of a complete skeleton of an armoured dinosaur, *Stegosaurus stenops,* which, although discovered near Canyon City, Colorado, so long ago as 1885, has only just been placed on public exhibition in the U.S. National Museum. Alongside is placed a restoration of the reptile as it probably appeared in life. When discovered, the skeleton was lying on its back, in such a manner as to suggest that the reptile had met its death by violence, and the remains have been mounted in the same position, the conformation of the back being displayed by means of mirrors arranged beneath.

In reference to the recommendation in the "First, Second, and Third Reports from the Committee of Public Accounts" that a periodical stocktaking should be instituted in national museums and galleries, and also that the results of such surveys should be subject to review by the Controller and Auditor-General, it is pointed out in the March number of *The Museums Journal* that in the British Museum alone a small

army of officials would be required for a task of this nature. It is added that if the registers in any museum or gallery are not properly kept up to date, the fault is due to the inadequacy of the staff.

THE report of the Department of Agriculture of the Union [illegible]th Africa has been issued in the form of a [illegible]ook. Although work has been disorganised by changes in administration, the report contains many interesting accounts of the investigations carried out by the various branches of the service. Amongst these may be mentioned the inquiry as to the cause of lamziekte (lame-sickness) undertaken by Dr. Theiler and Mr. Burtt-Davy, a discussion of which appears in the report of the agrostologist and botanist. Observations already made would appear to indicate that the complaint is not transmissible, and is more or less analogous with the "pica" disease of North Germany and the cornstalk disease of the United States. The view is expressed that the disease is due to the action of a plant poison, which is generated in grasses or other plants normally innocuous. Its development is associated with certain climatic and telluric conditions in which summer drought is an important factor. In this way the conditions responsible for the wilting of grass also favour the formation of the toxin, and this tends to explain the view commonly held that the disease is caused by the consumption of such wilted grass.

To the February issue of the Journal of the Meteorological Society of Japan Mr. J. Otsuki contributes a detailed report, accompanied by a map, of an eruption of Asama-yama on December 14, 1912. The author notes that this volcano has been particularly active in recent years. A violent outburst occurred 130 years ago, but from that time to 1909 the eruptions, though frequent, were of a minor nature. In May of the latter year an alarming eruption occurred, since when the volcano's activity has increased, no fewer than five serious outbursts being recorded in the past four years. The latest manifestation caused considerable consternation over a wide area. The reverberations of the explosion, which are likened to the booming of artillery, had earthquake-like effects on the near-lying villages, and were heard over an area of nearly 16,000 square miles, while a rain of white ash fell during the day of the eruption and the following day, covering ground extending for 2500 square miles. The column of dust and vapour rising above the volcano during the eruption was estimated to have been nearly two miles high.

SOME interesting details, accompanied by synoptic charts, relating to the disastrous hurricanes of November last in Jamaica are given in the United States meteorological chart of the North Atlantic Ocean for March, and in a report (No. 411) by Mr. Maxwell Hall, Government meteorologist for the island. Mr. Hall refers to three distinct disturbances: A, an ordinary depression until it curved round the west end of the island; B, a fully developed cyclonic hurricane which struck the south-west coast, travelling in a north-easterly direction; C, a small inland depression which broke the telegraph wires, November 16 and 17. On the morning of November 14 one of several useful warnings issued by the Washington Weather Bureau located a storm 400 miles south-west of Kingston; this storm Mr. Hall refers to by the letter B. At noon on November 17 the storm A was off Negril lighthouse, moving very slowly, and at midnight was overtaken by B. The subsequent action between these storms was very remarkable; Mr. Hall says:—"Every barometric pressure, as well as every direction of the wind, was affected by two or three cyclones, and with the data at hand it is not possible to separate the effects." After A passed out to sea north-east of Montego Bay, it returned rapidly southward, and placed itself between Kempshot on one side and cyclone B on the other. The registered wind velocity reached 120 miles an hour at Negril on the morning of November 18, and at Kempshot (Montego Bay) the same evening a similar rate was estimated. Several towns were entirely destroyed; at Savanna-la-Mar the sea wave was the highest within a century, and the sea was driven half a mile up the principal street.

ALMOST the whole of the March number of *Terrestrial Magnetism and Atmospheric Electricity* is devoted to a description of the theory, construction, and working of the earth inductor made by the Carnegie Institution of Washington for the determination of dip on board the magnetic exploring ship *Carnegie*. The coil of the inductor rotates about a diameter which can be set at any inclination and in any azimuth. Rotation of the coil will in general produce an alternating current, which only becomes zero if the axis of rotation coincides with the direction of the magnetic field at the place of observation. A telephone in series with the coil would determine the position of the axis for zero current, if the axis could be kept fixed in the proper direction. Since at sea this is not possible, the coil is provided with a two-part commutator, which rectifies the current and sends it through a moving-coil galvanometer. By reading the deflections of the galvanometer when the axis has several positions near the correct one, and the coil is rotated at a constant speed, the dip is determined on the *Carnegie* with an accuracy of about three minutes of arc.

THE volume of "Records of the Survey of India, 1910–11," contains discussions on the pendulum and latitude observations made in Sind and Baluchistan, where the arrangement of the mountain masses seems to show marked differences from that found in the vicinity of the main Himalayan region. In the first place, the average deflection of the plumb line is found to be remarkably small, and in general the attraction of the visible mountain masses is much less than could have been anticipated. The geological structure of the whole area is, however, very complicated, and it would appear that far more information, both as to the surface forms and as to the gravity variations, is required before any very definite conclusions can be drawn. Possibly, as suggested by Colonel Burrard, the Eötvös torsion balance might give information which would usefully supplement that derived from other sources. It is to be hoped that the Indian Survey will give a trial to this most in-

teresting instrument. A curious fact elicited is that there seems to be a slow alteration in the vibration periods of a number of pendulums at the same place, Dehra Dun. Thus all four pendulums used showed the apparent force of gravity as highest in January, 1904, and lowest in November, 1909, with a distinct rise since. No cause can be suggested to account for this variation. An investigation as to how far the Indian observations conform to the requirements of "isostacy" promises interesting results, but is as yet only in a preliminary stage.

THE *Alsatian*, which is the first of two quadruple-screw turbine steamers being constructed for the Allan Line, was launched from the yard of Messrs. Wm. Beardmore and Co. on March 22. An illustrated account of this vessel, which is 600 ft. long and of gross tonnage about 18,000, appears in *Engineering* for April 4. A notable feature is the adoption of the cruiser stern, an arrangement which permits of a greater displacement on a given length over-all, with corresponding increase in dead-weight, or, if the displacement be not increased, the lines may be fined down, so that the ship is more easily driven, with corresponding reduction in engine power. Further, the fuller water lines aft which are permissible with this type of stern ensure greater stability, especially at the deeper draughts. It is probable also that this form of stern tends to reduce the vibration due to the propellers. Hitherto the Board of Trade has only required a vessel to be capable of remaining afloat with any two adjacent compartments open to the sea. In the *Alsatian*, the aim of the designers has been to ensure her remaining afloat with four adjacent compartments open to the sea.

WE have received from Messrs. George Philip and Sons, Ltd., of Fleet Street, London, a specimen of a very handy, light terrestrial globe, 6 in. in diameter, showing by bold blue lines the new routes which will be opened when the Panama Canal is completed. "The Panama Canal Route Globe," as it is named, costs only 2*s*. 6*d*. net, and explains easily what a convenience to ocean travel the new canal will be.

MESSRS. CHARLES GRIFFIN AND CO., LTD., announce the following new books and new editions. In *Chemistry*:—The Petroleum Technologist's Pocket Book, by Sir Boverton Redwood, Bart., and A. Eastlake; Roberts-Austen: Addresses and Scientific Papers, together with a Record of the Work of Sir William Chandler Roberts-Austen, K.C.B., F.R.S., compiled and edited by S. W. Smith, illustrated; A Manual on the Examination of Fuel, by J. H. Coste and E. R. Andrews, illustrated; Outlines of Stationery Testing, by H. A. Bromley, illustrated; A Treatise on Petroleum, by Sir Boverton Redwood, Bart., new edition in three volumes, illustrated; A Handbook of Petroleum, by Capt. J. H. Thomson and Sir Boverton Redwood, Bart., new edition, revised throughout and added to by Major A. Cooper-Key and Sir Boverton Redwood, Bart., illustrated; The Synthetic Dyestuffs, and the Intermediate Products from which they are derived, by Dr. J. C. Cain and Dr. J. F. Thorpe, F.R.S., new edition. In *Engineering*:—Coast Erosion and Protection, by E. R. Matthews; The Dock and Harbour Engineer's Reference Book, by B. Cunningham; Electricity in Mining, by Siemens Brothers Dynamo Works, Ltd., illustrated; Griffin's New Guide to the Board of Trade Examination for Marine Engineers, by R. A. McMillan, part ii., Elementaries, Verbals and Drawing; Manual of Petrol Motors and Motor-cars, comprising the Designing, Construction, and Working of Petrol Motors, by F. Strickland, new edition. In *Geology*:—A Textbook of Geology, by Prof. J. Park, illustrated. In *Mathematics and Physics*:—Electricity and Magnetism, by Prof. J. H. Poynting, F.R.S., and Sir J. J. Thomson, F.R.S., 2 vols., vol i., illustrated. In *Metallurgy*:—Autogenous Welding: a Practical Handbook on the Installation, Working, and Manipulation of Oxy-Acetylene Welding Plant, for the Unition of Metals without Flux or Compression, from the French of R. Granton and P. Rosemberg, translated by D. Richardson, illustrated; Practical Assaying, by Prof. James Park, revised and enlarged from the third New Zealand edition; Rand Metallurgical Practice, vol. i., new edition. In *Technology*:—Engraving for Calico Printing, by W. Blackwood, illustrated; Painters' Colours, Oils, and Varnishes, Hurst's Practical Manual, new edition, revised throughout and re-written by N. Heaton, with a chapter on Varnishes by Dr. M. B. Blackley, illustrated; Painting and Decorating, by W. J. Pearce, new edition, illustrated.

OUR ASTRONOMICAL COLUMN.

NOVA GEMINORUM NO. 2.—In No. 4638 of the *Astronomische Nachrichten* three series of magnitude determinations of Nova Geminorum No. 2 are published. The first, from the University Observatory, Tokyo, commences with the nova's magnitude 5·1, on March 23, and observations were continued until August 17, when its magnitude was 7·89. Both the other sets of observations come from the Observatory of Cracow. The longer list gives the magnitude 3·96 for the nova on March 14; by the time the last determination was made, May 19, its light had dimmed to magnitude 7·60.

LIGHT-CHANGES OF α ORIONIS.—A list of 293 magnitude determinations of α Orionis, made between November, 1901, and August, 1912, by Mr. C. P. Olivier, of the Leander McCormick Observatory, is given in No. 4637 of the *Astronomische Nachrichten*. The table gives, in four columns, the date, Greenwich mean time, determined magnitude, and number of comparison stars used. The values found range from 0·21 (twice) to 1·06 (four times). Under the usual treatment the observations failed to reveal any regularity in the light changes.

PHOTOGRAPHS OF COMET BROOKS (1911*c*).—Dr. Luigi Taffara (*Mem. della Soc. d. Spett. Ital.*, disp. 1ª, vol. ii., ser. 2ª, p. 11) publishes an account of his photographic work on this comet during September, 1911. His observations were made at the Collurania Observatory in Teramo, at the invitation of Dr. Cerulli. The instrument employed was a Cooke triplet of 16·5 cm. aperture and 1·09 metres focal length. This camera was mounted on the equatorial constructed by Salmoiraghi (aperture 13·5 cm. and focal length 1·75 metres), which was used as a finder. In addition to giving a table of positions of the comet

for several dates, he publishes a series of photographs of its form, displaying the remarkable changes which the tail underwent.

FRANKLIN ADAMS CHART OF THE SKY.—The Royal Astronomical Society has undertaken the publication of a limited number of reproductions of the Franklin-Adams chart. The 206 sheets form a complete map of the whole sky, the area of each being 15° by 15°. It will be remembered that the original plates were secured with a 10-in. Cooke triplet objective of 45 in. focal length; the negatives show stars down to the sixteenth and seventeenth magnitudes. The reproductions will be on bromide paper, 15 by 12 in., the chart area being 11 by 11 in. The complete price will be ten guineas, and it is expected that the first sets will be ready for delivery in twelve months' time. It is hoped that a sufficient number of subscribers will be enlisted to help to defray the cost of such an expensive undertaking.

A CHEAP FORM OF GRATING SPECTROGRAPH.—In the current number of *Knowledge* (vol. xxxvi., No. 537, p. 142) Mr. A. H. Stuart describes what seems to be a new form of spectroscope in which a transmission grating is used. The instrument is there illustrated by two diagrams, and the principle involved can be easily grasped. The instrument is of the rectangular box form, having the slit and camera at one end of the box. The light, after passing through the slit, falls on an objective, at the back of and nearly in contact with it being placed a replica grating; behind this grating is placed a plane mirror at a distance of a few inches. The beam of light passes through the slit to the objective, and falls normally on the grating. A large portion of the light passes through the grating unchanged, and falls on the mirror. If it meets the mirror normally it will be reflected back to the grating, and a spectrum will pass out obliquely through the object glass and fall on the photographic plate at the camera end to one side of the collimator. In order to avoid the faint reflection spectrum the grating is retained in its position at right angles to the incident beam, but the mirror is slightly twisted. Thus a pure spectrum of considerable dispersion is obtained. Mr. Stuart has constructed such an apparatus by the judicious use of 20*s*., the achromatic lens, 2 in. in diameter, costing 3*s*. 6*d*., and the grating 10*s*. 6*d*.

KHEDIVIAL OBSERVATORY, HELWAN.—Two bulletins, Nos. 8 and 9, from this observatory indicate the useful astronomical work that is being accomplished in Egypt. The first gives an account of the method adopted and the results obtained in determining the astronomical positions of El Daba'a, Mersa Malrûh, Baqbaq, Sollûm, and Siwa. The work was carried out by Messrs. E. B. H. Wade and H. Knox Shaw.

The second of the two bulletins contains the results of the first three years (1909–11) of nebular photography with the Reynolds reflector obtained by Mr. H. Knox Shaw. It is stated that during this period the instrument was constantly undergoing alterations and repairs, so that some of the plates are not so good as they might be. Nevertheless, some of them afford considerable information as to the structure of some nebulæ not hitherto photographed. The table gives the new general catalogue numbers, the positions for 1900 and remarks, and four plates, each containing four or more reproductions, conclude the publication. Attention is directed to the advantage of making drawings of the smaller and less brilliant nebulæ from the negatives, a method which is capable of reproducing the general form of the nebula almost as accurately as any photographic reproduction.

THE DEVELOPMENT OF THE PARASITE OF INDIAN KALA-AZAR.

IN a recent memoir with the above title,[1] Captain W. S. Patton gives a detailed account of investigations carried on by him in Madras upon the development and transmission of the parasite of Kala-azar, commonly known as *Leishmania donovani*. As the result of numerous experiments with various blood-sucking insects, the author concludes that the transmission of Indian Kala-azar from man to man is effected solely by bed-bugs of the genus Cimex, and finds that the parasite develops as readily in *C. lectularius*, the species common in Europe, as in the Indian species, *C. rotundatus*. The development observed by the author takes place entirely in the digestive tract of the bug, and is in the main as follows.

The bug takes up the parasite from an infected person in the leishmanial form, that is to say, as the familiar "Leishman-Donovan body," contained either within white blood-corpuscles or in macrophages, in the peripheral blood. After being ingested by the bug, the parasites remain in an unchanged condition for some thirty-six to forty-eight hours. The earliest developmental changes in the gut of the bug may take place while the parasite is still enclosed in a leucocyte or after it has been set free by disintegration of the host-cell, and consist of an increase in the size of the parasite, with enlargement of its trophic and kinetic nuclei. As growth proceeds, the parasites may multiply by binary fission.

The next event in the development of the parasite is the formation of a flagellum, which takes place from the third to the fifth day after the last feed of infected blood. A young, growing parasite may, without dividing, become elongated and spindle-shaped, and acquire a flagellum; or it may first multiply by binary fission, after which each of the two daughter individuals acquires a flagellum; or the parasite may go through a process of multiple fission, in which the two nuclei, trophic and kinetic, divide each into eight or more, and as many flagella grow out, with subsequent division of the body into a number of flagellated daughter-individuals. However the details of the process may vary, the final result is the same, and by the fifth day the parasites, considerably increased in number, have the form of long, actively moving flagellates of the Herpetomonas type, familiar to all those who have studied the development of the parasite in artificial cultures ever since these changes were first discovered and described by Rogers.

About the sixth or seventh day the flagellate parasites are observed to be attaching themselves by their flagella to the intestinal wall of the bug. When thus attached, the body of the parasite slowly rounds up and at the same time it divides; the smaller forms thus produced divide again, and meanwhile the flagellum becomes shorter, and finally disappears altogether. The result of these changes is that the parasite reverts again from the herpetomonad phase to the form of the small, non-flagellate leishmanial body, distinguished by the author as the "post-flagellate" phase, though it does not appear to differ in any essential detail from the initial "preflagellate" leishmanial form, but is described as having a distinct envelope ("periplast"). The post-flagellate stage in the bug begins about the eighth day, and is completed by the twelfth.

According to Captain Patton, this post-flagellate stage represents the final stage of the development of the parasite in the bug. He

[1] Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. No. 53, "The Development of the Parasite of Indian Kala-Azar." Pp. v+38+1 plate. (Calcutta: Government Printing Office, 1912.) Price 1*s*. 2*d*.

believes that the post-flagellate phase finds its way back again to the human being, when the bug feeds again, by regurgitation from the intestine. Proof of this is as yet lacking, but he hopes in future experiments to solve this part of the problem once and for all. He states that if the bug takes a fresh feed of blood when the parasites in its intestine are in the flagellated phase, they are all destroyed, and cannot develop further. "Human blood has some body in it which not only prevents the process of flagellation, but also destroys the flagellates. This substance is in all probability the complement, and it is known that it is itself destroyed in about two days, when blood is drawn from the human body. This fact further explains why the parasite only begins its development in the bug on the second day. . . . Though many bugs may become infected, only those which do not feed again till the parasite has passed back to its post-flagellate stage are infective." He believes that only in its "post-flagellate" leishmanial form can the parasite resist the destructive action of fresh blood and re-infect the vertebrate host.

The author's conclusion that a non-flagellate leishmanial stage is the final phase in the development of the parasite in the insect-host is based largely on a comparison with the herpetomonad parasites of insects; that is to say, on an analogy with species which are parasitic in invertebrate hosts alone and have no alternate vertebrate host in their life-cycle. In such species, however, the infection of new hosts is effected (apart from the possible occurrence of "hereditary" infection) by the contaminative method; that is to say, by means of resting, non-flagellate phases, usually encysted, which pass out of the host in the fæces, and are accidentally swallowed by another insect-host. On the other hand, in all known cases where a flagellate parasite has an alternation of hosts, vertebrate and invertebrate, and where the vertebrate host is infected by the inoculative method, that is to say, by the parasite being injected into it through the mouth-parts of the invertebrate in the act of sucking blood; in all such cases that have been investigated accurately up to the present, the final stage of the parasite in the invertebrate host is an active flagellate. Further, it has been frequently observed in, for instance, the development of trypanosomes in their alternate invertebrate hosts that the active, flagellate forms, usually crithidial or herpetomonad in type, may pass temporarily into a resting, non-flagellate, leishmanial phase during hunger-periods, when the ingested blood is digested and absorbed, and become active flagellate forms again when the host takes in a fresh supply of food.

From these considerations the possibility is not to be excluded at present that Captain Patton's observations may be capable of an interpretation different from that which he places upon them. It may well be that his "post-flagellate" stage represents a resting phase upon which the parasite enters when the blood taken up by the bug is digested, and that when the bug feeds again these resting forms will become active once more, and give rise to a final flagellate stage, yet to be discovered, which will be inoculated ultimately into the human being. It must, however, be borne in mind that it has not yet been proved definitely that the parasite passes from the bug into the human being by inoculation through the proboscis; if, as is at least possible, the parasite is destined to pass out of the bug in its fæces, it is then probable in the highest degree that the final stage in the development in the bug would be a resting, non-flagellate phase.

The final decision, however, with regard to the transmission of the parasite of Kala-azar will rest, not upon analogies with other parasites, but upon facts demonstrated with regard to this parasite itself, and if Captain Patton establishes his statements, he will have added a new type of development and transmission to those known already to occur in flagellate parasites of vertebrates transmitted by blood-sucking invertebrates. However this may be, the author is to be congratulated on having brought forward very strong evidence to show that, as sug[illegible] originally by Rogers, the spread of this very deadly human disease is to be attributed to the agency of the bed-bug, a discovery of immense practical importance.

E. A. MINCHIN.

NEW ZEALAND VEGETATION.[1]

IN a brief general account, contributed to the "New Zealand Year-book, 1912," Dr. L. Cockayne F.R.S., who has done so much floristic and ecological work in New Zealand, points out that owing to its long isolation and diverse elements (Malayan, Australian, subantarctic, and endemic), the flora of New Zealand is of special interest.

The vascular plants in this flora—ferns, fern-allies, and seed-plants—number, so far as at present known, about 1700 species, of which about three-fourths are endemic. Of the lower plants—algæ, fungi, lichens, liverworts, and mosses—many hundreds have been described, including many remarkable genera and species, but there can be no doubt that hundreds more remain to be described. The ferns and fern-allies form a striking feature in the vegetation in some areas, but are not of such great relative importance in the New Zealand flora as has sometimes been supposed; still, about 160 species of these plants are known.

Among the seed-plants, the daisy family is the largest, as might be expected, having more than 230 species; the sedge, grass, and figwort families follow with more than 100 species each, while between thirty and seventy species belong in each case to the orchid, carrot, buttercup, bedstraw, epacrid, willowherb, pea, rush, and forget-me-not families.

Among genera which contain many species and are marked by great variability, making them difficult to define and classify, Dr. Cockayne mentions Veronica, Carex, Ranunculus, Senecio, Epilobium, and Myosotis. The genus Veronica, with more than 100 species, is remarkable for its variability and for the almost endless variety of habit assumed by the various species, some of the New Zealand speedwells (mostly endemic and largely alpine in habitat) being small trees, while the majority are shrubby and often dwarf, frequently simulating cypresses and other conifers owing to their reduced and appressed leaves. Apart from variability in the adult plants, about 100 New Zealand species, belonging to different genera, have juvenile forms which are quite distinct from the adult forms, and may retain their juvenile characters for many years; this is seen in various trees, such as lace-bark, lancewood, and ribbonwood.

Among the multitudinous growth-forms, characteristic of diverse life conditions, the more remarkable are the climbers with woody rope-like stems, resembling the lianas of the South American tropical forests; shrubs with wiry interlaced branches forming close masses; the curious cushion-plants, sometimes of immense size, as in the vegetable sheep (species of Haastia, Raoulia, and Psychrophyton); leafless shrubs with round or flattened stems, and so on. The woody plants are almost all evergreen, only some twenty species being deciduous or semi-deciduous; herbs that

[1] "The Flora of New Zealand." By Dr. L. Cockayne. Extract from the "New Zealand Year-book, 1912."

die to the ground in winter are rare, as are bulbous plants.

The plant associations of New Zealand, on which Dr. Cockayne has written so extensively,[2] are of surpassing interest; to find an equal variety a continent extending to the tropics would have to be visited. The northern rivers and estuaries display a mangrove vegetation—a unique and unexpected occurrence outside of the tropics. The lowland and montane forests are of the tropical rain-forest type, and are distinguished by the abundance of filmy ferns, tree-ferns, woody climbers, massive perching plants, deep carpets of mosses and liverworts, and trees with buttress-roots. The high-mountain forests are subantarctic in character, and are usually dominated by the southern beech (Nothofagus). Wide areas are covered by shrub heath, fern heath of tall bracken, and moorland with bogs, while grass-land with tussock grasses is a great feature of the volcanic plateau of the North Island and of the east of the South Island; species of Poa and Festuca form the chief tussocks of the lowlands and lower hills, but at higher altitudes species of Danthonia are dominant.

The alpine vegetation contains, excluding lowland plants which ascend to the mountains, about 550 species, most of which never descend below 1500 ft. altitude, while some are confined to the highest elevations. The most beautiful of New Zealand flowers, with but few exceptions, belong to this mountain flora—the great white and yellow buttercups, the marguerite-flowered celmisias, and the variously coloured ourisias, eyebrights, forget-me-nots, and many more. The growth-forms are often striking—cushion-plants, rosette-forming plants, stiff-branched shrubs, mat-forming plants, and other xerophytes are much in evidence, showing the usual xerophilous leaf-characters (hairiness, leathery structure, rigidity, needle-points, &c.).

The floras of the Kermadecs, Chatham Islands, and the Subantarctic Islands (Snares, Auckland, Campbell, Antipodes, Macquarie)—island groups far distant from the mainland—are distinctly part of that of New Zealand. The Kermadecs contain 114 species of vascular plants, only twelve of which are endemic, while seventy-one belong to New Zealand proper; the largest island (Sunday Island) is covered with forest in which *Metrosideros villosa*, a near relative of the pohutakawa (*M. tomentosa*), is the dominant tree. The Chatham Islands have 235 species, twenty-nine of which are endemic, while the remainder of the flora is found on the mainland. The chief plant associations are forest, moor, and heath; on the moors are great thickets of the purple-flowered shrub *Olearia semidentata*, while there are two remarkable endemic genera, Coxiella (an Umbellifer) and Myosotidium (a giant forget-me-not)—both now almost extinct, unfortunately. The Subantarctic Islands have a dense vegetation consisting of 194 species, of which no fewer than fifty-two are endemic, the rest occurring in New Zealand, but chiefly in the mountains. Forest is found only on the Snares and the Aucklands, the dominant trees being an Olearia and a Metrosideros respectively. Very dense scrubs occur on the Auckland and Campbell Islands, and moors are characteristic of all the islands, owing to the enormous peat-deposit and the frequent rain. The Cook Islands, though forming a part of the dominion, have a Polynesian flora quite distinct from that of New Zealand, and are therefore not included in Dr. Cockayne's notice, while, on the contrary, the flora of the Macquarie Islands, though belonging to Tasmania, is a portion of that of New Zealand.

[2] See, for instance, the papers reviewed in NATURE, vol. lxxxviii., pp. 51, 590.

The indigenous flora has been invaded by an important introduced element, consisting of about 540 species, mostly European, which has followed in the wake of settlement. Dr. Cockayne points out that although these aliens are in active competition with the true native plants, the widespread opinion that the latter are being eradicated in the struggle is quite erroneous. Where the vegetation has never been disturbed by man, there are no foreign plants at all, but where man has, by farming operations, stock-raising, and burning, brought about European conditions, the indigenous plants have given way before artificial meadows with their economic plants and accompanying weeds. On the tussock-grass areas, however, invaders and natives have met, and though the original vegetation has changed, there is no reason to consider the one or the other as the victor. On the contrary, it appears likely that both will persist, and in course of time a new flora and vegetation will be evolved.

F. C.

PALÆOZOIC AND OTHER ECHINOIDS.[1]

THE Echinoidea afford probably greater opportunities for accurate phylogenetic study than any other class of animals. This is due to the fact that a fossil Echinoid is, when well preserved, often as complete for morphological, and even ontogenetic, examination as a recent specimen. No work on recent Echinoids could be adequately carried out without reference to the fossil forms, while any classification of the group based on structures other than skeletal would exclude more than half the available material.

There could be no better proof of the absolute interdependence of zoology and palæontology than the volume before us. The work aims primarily at a revision of the known Palæozoic Echinoids, but before the characters and relations of those highly specialised forms can be well understood, an exhaustive general survey of the morphology of the whole class is necessary. Conversely, it is surprising, but none the less gratifying, to find that the fullest account of the lantern of a recent Echinoid yet published is included in a work mainly concerned with Palæozoic types.

In the introduction a valuable summary of the methods of research (based largely on those of Hyatt) is given, together with useful technical hints for the preservation and development of recent and fossil Echinoids.

The first section of the work is devoted to a detailed account of the comparative morphology of the class. Beside the study of the lantern already mentioned, three features stand out preeminently in this part. Teratological and other irregularities of development are here systematised for the first time, and their value in the interpretation of normal conditions is clearly established. The apical system, considered biometrically, is found to yield important evidence of the direction of evolution in species, especially among the regular Echinoids. But perhaps the most noteworthy conclusion reached concerns the actual composition of the test. It is shown that the only parts of the Echinoid skeleton that occupy an interradial position are the genital plates and the braces of the lantern. Each interambulacrum is really composed of two separate halves, each half having its origin in the same ocular plate as the contiguous ambulacrum.

The systematic classification contained in the second section of the work is concerned chiefly with the regular Echinoids. The only striking novelty is found

[1] Memoirs of the Boston Society of Natural History. Vol. vii., "Phylogeny of the Echini," with a Revision of Palæozoic Species. By Robert T. Jackson. Pp. 491+76 plates. (Boston: Printed for the Society, 1912.)

in the subdivision of the Centrechinoida (*olim* Diademoida). Here the characters of the jaws are used as the guiding features in the separation of three suborders.

The final part of the paper gives a complete survey of all Palæozoic Echinoids hitherto described, and, naturally, includes the description of several new genera and species. The completeness of the revision may be gauged from the fact that figures are given of all but four of the known species. The seventy-six plates accompanying the paper are partly photographic and partly diagrammatic, both alike admirably clear. A full bibliography and an adequate index bring to a fitting conclusion a work that must always remain a classic to echinologists, and a model to workers on other groups. H. L. H.

CHEMISTRY OF THE SUGARS.

PROF. EMIL FISCHER'S latest paper in the final part of the Berlin *Berichte* for 1912 brings another chapter in the chemistry of the sugars to a close. His welcome return to the subject has been attended with the same brilliant experimental dexterity which led to his former successes in this remarkable group of compounds, and it is to be hoped that he will yet succeed in conquering the still unsolved problem of the synthesis of the disaccharides. Fischer now describes the conversion of ordinary glucose into a methyl pentose, and is enabled to clear up the constitutional formulæ of the stereoisomeric methyl pentoses and effect their complete synthesis from the elements.

The methyl pentoses are a somewhat remarkable group of compounds; they represent sugars of the type of glucose in which one hydroxyl group is reduced so that $CH_2.OH$ is replaced by CH_3. At first their occurrence was rare and limited to a few coloured glucosides. Many more of these have been described recently, but the group is most widely represented amongst the seaweeds, the investigation of which we owe to Votoček. As a result of his work, several isomerides of rhamnose, the methyl pentose which was first discovered, are known.

Fischer started from a dibromo-derivative of glucose, discovered by Fischer and Armstrong ten years previously. The one bromine atom in this substance is attached to the carbon atom at one end of the chain of carbons which constitutes the skeleton of glucose; it is easily replaced by methoxyl and a glucosidic compound formed. The position of the second bromine was uncertain; there were reasons for considering it as attached to the other end of the chain. This position is now confirmed by the fact that when the bromine atom is reduced the glucoside of a methyl pentose is formed from which the methyl pentose is in turn obtained. The new sugar proves to be identical with a compound described by Votoček, and receives the name isorhamnose. Its configuration formula must be the same as that of glucose, and it is easy to deduce the formula of rhamnose and other members of the group.

A side issue of the research, which, however, possesses the very greatest interest, is the behaviour of the new glucoside of isorhamnose towards enzymes. Like the β-methyl glucoside, from which it is derived, it is hydrolysed by emulsin, though somewhat more slowly. Apparently the substitution of CH_3 for $CH_2.OH$ is not sufficient to put the compound out of harmony with the enzyme; this is what might be expected in view of Irvine's proof that tetramethyl-β-methyl glucoside is likewise hydrolysed by emulsin. It is therefore all the more remarkable that β-methyl xyloside, which differs only in that the CH_3 group is replaced by H, is not acted on by the enzyme in the very least.

A more striking proof of the selective nature of enzyme action could not well be desired, and the moment is opportune to emphasise this fact, since it is fundamental to the interpretation of vital phenomena. E. F. A.

GYROSTATS AND GYROSTATIC ACTION.[1]

WE are accustomed in daily life to handle non-rotating bodies, and their dynamical properties excite little attention, though it cannot be said that they are commonly understood. It is different, however, with rotating bodies. These, when handled, seem to be endowed with paradoxical, almost magical properties. I have here an egg-shaped piece of wood. I place it on the table and it rests, as we expect it to do, with its long axis horizontal. Our experience tells us that this is the natural and correct position of the body. But I set it spinning rapidly on the table, as you see, with the long axis horizontal, and you observe that after an apparently wobbling motion it erects itself so that its long axis is vertical. It was started spinning about a shortest axis, but the body has of itself changed the spin, and it is now turning about the long axis. In taking this position it has actually raised itself against gravity, through a height equal to half the difference between the lengths of the long and short axes. This seems paradoxical, but the man who is in the habit of spinning tops knows that this is the proper position of the body, that it must stand up in this way when spinning rapidly on a rough horizontal plane.

This experiment may be performed at the breakfast table with an egg as the spinning body. But the egg must be solid within—that is, it must be hard-boiled; a raw or soft-boiled egg will not spin. Perhaps this was why Columbus did not adopt this method for his celebrated experiment; there may, of course, have been other reasons.

It is thus made clear that by causing a body to rotate rapidly we endow it with new and strange properties. Between a top when spinning and the same top when not spinning there is a difference which reminds us of that between living and dead matter; and this will strike us still more forcibly when we consider some more complicated cases of rotational motion. The top, the ordinary spinning-top of the schoolboy, stands on its peg and "sleeps" in the upright position, in contempt of all the laws which govern statical equilibrium.

The experimental study of spinning-tops is carried on by very small boys and a few more or less aged people. Somehow, but I think quite wrongly, a top is regarded as a toy suitable only for a child, and that kind of amusement is scarcely encouraged by the benevolent despots who so completely direct the games of boys at school. Among older boys there used to be a regular game in Scotland of "peeries," and some of you may have read Clerk Maxwell's poetical description of the Homeric contests which distinguished the sport.

The top as a plaything is depised; nevertheless it is a most important contrivance. The earth on which we live is a top, and a considerable range of astronomical phenomena are most easily explained by reference to the behaviour of ordinary spinning-tops. It is a top that directs the dirigible torpedo, that controls the monorail car, which may soon rise from the posi-

[1] Discourse delivered at the Royal Institution on Friday, February 14, by Prof. Andrew Gray, F.R.S. The motor-gyrostats described are the invention of Dr. J. G. Gray and Mr. G. B. Burnside. The gyrostatic tops and combinations used in the latter part of the lecture are due to Dr. Gray.

tion of a small model to that of an important affair of practical railway engineering, and that in the gyrostatic compass gives a direction-pointer unaffected by the iron of the ship, or the rolling and pitching of the vessel. Its properties (summed up in what we call gyrostatic action) have to be reckoned with in all swift-running machinery, such as fast-speed turbines, and rotary engines of all kinds, especially if these drive flywheels or propellers. They affect very seriously the stability of aëroplanes, and even of submarines, and I am very doubtful if aviators have yet become in sufficient degree instinctively alive to the dangers of sudden turnings, such as those which are encouraged by the promoters of aviation displays in alighting competitions.

The man who has spun and studied tops and gyrostats appreciates as no one else can the extreme importance of properly balancing rotating machinery, and of avoiding gyrostatic action where such action is likely to interfere with the running of the machine as a whole.

FIG. 1.—Motor-gyrostat in "fork and pedestal" mounting.

The properties of a top are best studied in the gyroscope, or gyrostat, as it is better called. Here is a simple gyrostat, of the ordinary form sold in the toyshops, but with some important modifications to enable it to run for a long time at a high speed. It consists, as you see, of a heavy-rimmed metal disc, or flywheel, capable of rotation with but little friction on pivots held in sockets attached to a metal frame. Thus the flywheel may, by the quick withdrawal of a string wound round its axle, or in some other way, be set into rapid rotation in the frame, which in turn is mounted in various ways to show gyrostatic effects. But this ordinary form, as well as some others of a more pretentious character, suffers from the great disadvantage of having no means of maintaining the spin, and the continual renewal of the spin is a great nuisance.

I have here a gyrostat (Fig. 1) in which this drawback has been overcome by the simple and effective device of making the flywheel itself the rotor of a high-speed continuous-current electric motor. The ordinary gramme-ring armature is well adapted for this. It gives a wheel of great moment of inertia, or, as I call it, "spin inertia" (that is, the matter of the wheel is distributed so as to be on the whole as distant from the axis as possible), which can be run at high speed for a long time without trouble of any kind from bearings or contacts.

For my first experiments the motor gyrostat is set up with the axis of the flywheel horizontal, in this mounting, which consists, as you see, of a fork perched on a pillar. Notice the possible motions, the freedoms, I may call them, of the arrangement. The flywheel can turn about its axle, the case can turn about the line of the pivots which carry it in the fork, and the fork about a vertical axis provided in the pillar. These three axles, which we shall number (1), (2), (3), are mutually at right angles and meet at the centre of gravity of the movable system or gyrostat proper. When thus set up the gyrostat is said to be freely mounted.

With the flywheel at rest I push down on one side of the case, and immediately turning takes place, as we should expect, about the axis (2). Pushing down the other side of the case causes the instrument to turn about the axis (2) in the opposite direction. I grasp the fork in my hands and turn it about the axle (3) in either direction. Nothing unexpected happens; the gyrostat turns with the fork, its axis remaining horizontal throughout. Again, I grasp the pillar in my hands and turn it on the table, and you see that the friction of the axle (3) is sufficient to cause the fork and gyrostat to move round with the pillar. As before, the axis of the flywheel remains horizontal.

My assistant now causes a current of electricity to flow in the coils which form part of the flywheel and in the coils which surround the soft iron core of the magnet which is stationary within the ring. So far you can only tell that the flywheel is turning by the faint hum which its motion sets up. But when I repeat the operations which I have just performed on the non-rotating gyrostat, the behaviour of the instrument is quite startlingly different. I push down on one side of the case as before; a resisting force is experienced, and the gyrostat turns, not visibly about the axle (2), but about (3), the vertical axis. So long as I maintain the tilting force so long does the resistance and this turning about the vertical persist. I withdraw the tilting force, and the turning motion ceases.

Now I would direct attention to these rods with arrow-heads, which are screwed to the gyrostat case. This curved one shows the direction in which the flywheel is spinning. The straight rods are intended to represent the spin-momentum and the tilting action respectively. Both are completely known when their amounts and their planes are known. The spin-momentum is got by multiplying two numbers together, one representing the spin-inertia of the wheel (which is greater the more the mass is placed in the rim), the other the speed of turning. The turning action or "couple" is also got by multiplying the force with which I push by the arm or leverage of the force about the axis. So then we represent these two by lines drawn at right angles to the two planes, making the lines of lengths to represent the two products. Standing on one side of the plane of the flywheel, you see it turning against the hands of a clock; standing on one side of the plane of the turning action I apply you observe that action tending to turn the body also against the hands of a clock. The two lines representing the two products drawn towards you from the two planes represent also the directions of the turning actions of the couples. For example, the direction of rotation of the flywheel being that shown by the curved rod, the line representing the spin-momentum points outwards from the side of the gyrostat to which the rods are attached. I call this the *spin-axis*. The other line representing the turning action which I applied I call the *couple-axis*.

Now observe that I set the couple-axis so as to

point toward your left. I push down the side of the gyrostat nearest me, and you see that the spin-axis turns towards the left. Again, I turn the couple-axis so as to point to your right. When so placed it represents a turning action tending to depress the end of the axle of the flywheel that is nearest you. I apply such an action and the spin-axis turns towards your right. In both cases the spin-axis turned towards the instantaneous position of the couple-axis.

Now I set the couple-axis vertical, pointing up. It represents a turning action tending to produce horizontal turning in the counter-clock direction as seen from above. I apply such an action to the fork, when you see that the gyrostat turns the spin-axis towards the upward direction. Finally, I set the couple-axis vertical but pointing down, as in Fig. 1. It now represents a turning action tending to produce clockwise rotation as viewed from above, counter-clock rotation as seen from below. I apply the action represented and the gyrostat turns the spin-axis towards the downward direction.

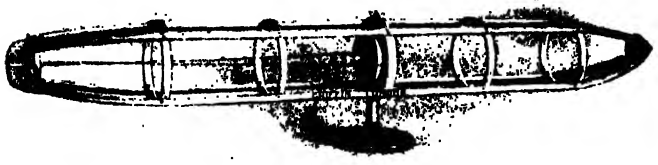

FIG. 2.—Motor-gyrostat mounted to demonstrate the principle of the dirigible torpedo.

These experiments may be summed up as follows:—The flywheel is spinning about axis (1). Any attempt to tilt the gyrostat about axis (2) produces turning about (3); an attempt to tilt it about (3) produces turning about (2). This response of the body seems paradoxical, but in point of fact, and this is the secret of the whole affair, *this turning of the body as a whole amounts to the production of spin-momentum about the couple-axis at exactly the proper rate.* It is quite easy to prove this by the consideration, in the most elementary way, of the accelerations of the different particles composing the wheel.

The turning of the spin-axis towards the couple-axis is called a precessional motion, from a similar motion of the earth which produces the astronomical phenomenon called the precession of the equinoxes. The turning action, or couple, as I shall now call it, may be said to cause the flywheel to "precess" towards the couple-axis. This relation of directions is very important, and should be kept always in mind.

If this turning response of the body, about an axis which we shall call (3), is prevented when turning about an axis (2), at right angles to (3), is changing the direction of the axis of a rotor—an axis (1), say, at right angles to (2) and (3)—a preventing couple, usually called *gyrostatic*, about the axis (3), must be applied by the bearings to the axle of the rotor, and therefore an equal and opposite couple by the axle to the bearings. This couple, it is easy to prove, is equal to the product of the spin-momentum and the angular speed at which the direction of the axis of the rotor is being changed. Thus the greater the moment of inertia of the rotor, or its angular speed, or the angular speed of the change of direction of the axis, the greater is the gyrostatic couple.

For example, the rotor of a dynamo, mounted on one of the decks with its rotor-axis athwart ship, applies, when the ship rolls, a couple to the bearings, the plane of which is parallel to the deck, and which consists of a forward force on one bearing and a sternward force on the other. These forces are reversed with reversal of the direction of rolling, so that an alternating force is applied to each bearing tending to shear it off the deck. Thus if the bearings are at all loose, the axle will knock alternately on the front and back of each bearing.

Similarly the axle of the rotor of a fore-and-aft turbine, when the ship pitches, applies a force to port to the bearing at one end, and a force to starboard at the other end, which forces are reversed when the direction of the pitching motion is reversed. When the course is being changed the forces of the gyrostatic couple are applied to the top of one bearing and the bottom of the other.

Now, returning to the pillar-gyrostat, and putting the flywheel in rapid rotation, I turn the pillar round on the table. I have turned, as you see, the base round through one revolution, and throughout the turning motion the axle of the flywheel has remained pointing in the same direction. The friction at the axle about which I have turned the pillar, which, you will remember, was sufficient to carry the gyrostat round when there was no spin, is now quite insufficient to cause any serious change of position of the gyrostat. Only a very small couple producing precession acted.

This experiment illustrates the principle of permanence of direction of the axis of rotation, in the absence of a couple producing precession, the principle on which depend the gyrostatic compass and the self-directing torpedo. Carried within the body of the torpedo is a fast-spinning gyrostat, and at the instant at which the torpedo leaves the impulse-tube this gyrostat is mounted freely with its axis coincident with that of the torpedo—that is pointed, so to speak, exactly along the "cigar." Any turning of the torpedo body sideways brings about a relative shift between the gyrostat and torpedo axes, and this shift brings into operation a vertical rudder at the stern of the torpedo. If the nose of the torpedo turns to port, the rudder steers the craft to starboard, and *vice versâ*.

FIG. 3.—Motor-gyrostat in pedestal, with weight attached.

Here (Fig. 2) is a skeleton frame representing a torpedo. It is mounted on a vertical axle, and carried on pivots within the structure is one of our motor-gyrostats. At the stern of the frame is a small rudder, and this is connected by means of cords to the gyrostat. I set the flywheel in rotation. When, as I do now, I turn the nose of the torpedo to port, the rudder

steers to starboard; when I turn the nose to starboard the rudder steers the craft to port.

The case of the pedestal gyrostat is provided with a hook at one extremity of the axis (see Fig. 3). The effect of hanging a weight on this hook is to apply a couple tending to cause turning about the axis (2)—that is, which would produce such turning if the flywheel were not spinning. But the wheel is spinning, and the visible actual turning is about the axis (3). Observe also that the wheel is rotating comparatively slowly, and that the precessional motion is great. I increase the speed of the flywheel and the gyrostat precesses more slowly. I replace the weight by a larger one, and for the same spin the precessional motion is greatly increased. Thus for a given applied couple the faster the spin the slower the precessional motion, and for a given spin the greater the couple the faster the precessional motion.

Now while the weight is in position and the gyrostat precessing about the axle (3) I attempt to hurry the precessional motion, and immediately the gyrostat turns about the axis (2) so as to *rise* against gravity. I try to delay the precession, and again the gyrostat turns about the axis (2), but now so as to descend under gravity.

Without being aware of it people are constantly meeting with examples of gyrostatic action in daily life. A child expert in trundling a hoop causes it to turn its path to the right or left, by striking it a blow at the top with the hoop stick, the effect of which the ordinary person would suppose, if he thought about it, should be to make the hoop to fall over to the right or the left. A bicyclist riding without holding the handles leans over to the right if he wants to steer the bicycle to the right, and to the left if he wants to steer to the left. And if he feels himself falling over to right or left he turns the handles instinctively so as to turn the bicycle to that side, when the machine resumes the upright position. In the bicycle, however, the spin of the wheels is not the most important action to be taken account of.

The gyrostatic action in the bicycle is much more marked in a motor machine, for in that a massive flywheel rotates in the same direction as the wheels. As the bicycle turns a corner it is constrained to precess, and a couple is needed to produce this precession of the rotating parts quite apart from that required to turn the rest of the machine. This the rider applies by leaning over to the *inside* of the turn, and leans over more than he would have to do if the flywheel were not there or were not rotating.

Good examples of gyrostatic action are given by paddle and turbine steamers. A paddle steamer is steadier in a cross-sea than a screw steamer of the same size. This is due in part to the gyrostatic action of the paddle-wheels, which, but for their comparatively slow speed of rotation, would form a compound gyrostat of considerable power. For this gyrostat the spin-momentum may be conveniently represented by a line drawn from the steamer towards the port-side. A couple tending to tilt the steamer over to starboard is represented by a line drawn towards the bow, and a couple tending to tilt the steamer to port by a line drawn towards the stern. Hence, if the steamer heels over to starboard, her bow, in consequence of gyrostatic action, precesses to starboard, but the starboard wheel, becoming somewhat more deeply immersed, uses more power and exerts a turning influence to port. Thus the steersman has less difficulty in keeping the vessel on a straight course.

But if the vessel be turned by the rudder, say to port, the vessel will by gyrostatic action be slightly heeled over to starboard, and the starboard wheel, being more deeply immersed, will assist the turning action of the rudder.

Though the gyrostatic action of the wheels is not very great, calculation shows that it is enough to produce an appreciable variation in the immersion of the wheels.

The gyrostatic action of the flywheel in a motor-car is of some practical interest. The flywheel is placed with its plane athwart the car—that is, with the axis, so to speak, fore and aft. It rotates in the clockwise direction as viewed by an observer behind the car. The effect of turning a corner to the left gives a gyrostatic couple, throwing the weight of the car more on the back wheels; turning to the right throws the weight more on the front wheels. The forces applied by the ground to the front wheels are diminished in the former case and increased in the latter. There is danger, therefore, of the steering power of the car being interfered with, if the corner is taken at too great a speed.

As a final example, we take an aëroplane. Here the rotor of the engine and the propeller together form a compound gyrostat of considerable power. As the bearings are fore and aft, the action is similar to that of the flywheel of the motor-car. Turning horizontally in one direction gives rise to a gyrostatic couple tending to make the aëroplane dive, turning the

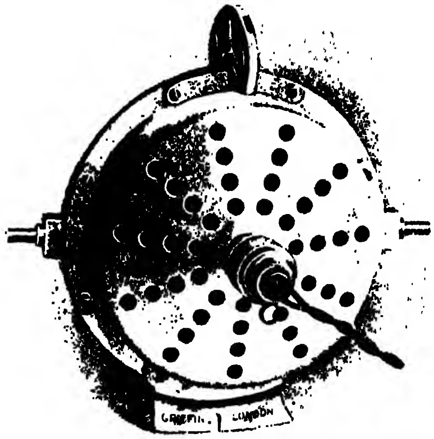

FIG. 4.—Motor-gyrostat balancing on a skate.

opposite way sets up a couple which makes the aëroplane rear up in front. If the aëroplane is kept horizontal such couples have to be balanced by stresses in the framework. These considerations show that sudden turning of aëroplanes should, if possible, be avoided. Manœuvres calling for such turning are accompanied by very considerable danger. No doubt aviators are aware of the existence of gyrostatic action, but there is considerable haziness in people's minds as to its direction in the various possible cases. The peculiar properties of rotating bodies need not, of course, be understood theoretically by aviators, though it is well to know something about them. But the aviator, like a person walking or swimming, must know instinctively what to do in an emergency, and what motions must be avoided. The gyrostatic action he has to contend with lies hid, as it were, until he tries some new and violent manœuvre; and then it brings him to grief.

I now pass on to some special experiments which can be carried out with these motor-gyrostats. First

take one or two old experiments (see Thomson and Tait's "Natural Philosophy," § 345[x] *et seq.*), which are more effectively performed with these fast-running instruments. Here is a skate attachment (Fig. 4) on which I place the gyrostat after its speed has been adjusted to the moderate value of about 6000 revolutions per minute. The plane of the flywheel is in-

FIG. 5.—Motor-gyrostat on gimbals

clined to the vertical, and you see that the top does not fall down, but precesses round on the table. I increase the inclination and the precession becomes more rapid. Now I attempt to hurry the precession, and the gyrostat stands up erect; I try to resist the precession and the gyrostat falls over.

I mount the gyrostat with its wheel horizontal over

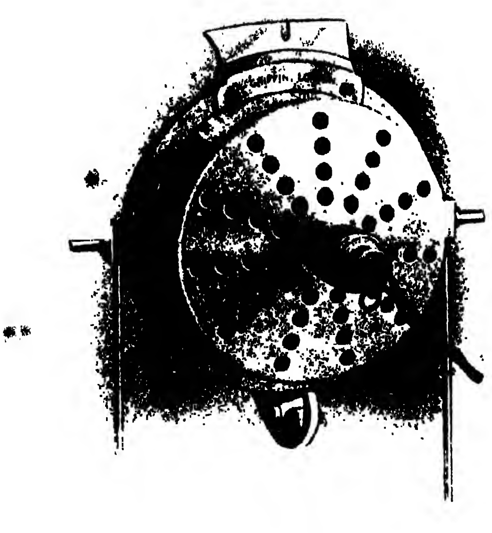

FIG. 6.—Motor-gyrostat balancing on stilts.

a flexible support, in the present case a universal joint (Fig. 5). Without rotation the instrument would fall over at once, but you see that it stands stably erect when the flywheel is spinning, and has a precessional motion when disturbed from the upright position.

Again, here is a two-stilt support (Fig. 6). One of the stilts is held by a long socket, at one side of the case, and may be regarded as rigidly attached. The other stilt is simply a bit of wire pointed at both ends; one end rests on the table, the other, the upper end, rests loosely in a hollow in the under-side of this projecting piece attached to the case. The gyrostat is thus supported between two stilts, one fixed the other quite loose, and its axis is at right angles to the plane of these when the arrangement stands upright. It would be hard to devise a more unstable support. You see that there is no possibility of making the arrangement stand up without spin. But you see, on the other hand, that there is a fair amount of stability with the flywheel spinning if the arrangement is allowed to oscillate, or, as one might say, wriggle, backwards and forwards, horizontally.

In the next experiment (due originally, I have been told, to the late Prof. Blackburn) the gyrostat is rigidly

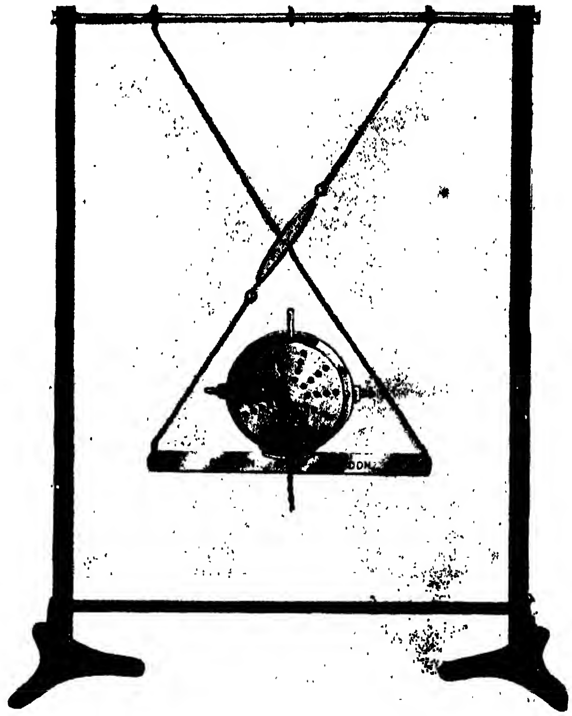

FIG. 7.—Motor-gyrostat on crossed bifilar support.

clamped to this metal bar, which, as you see, is hung by two chains attached to its ends. The chains have been crossed by passing one through a large ring in the middle of the other. I turn the gyrostat so that the chains and the rim of the case are in the vertical plane. You observe that the arrangement is one of instability. The gyrostat has perfect freedom to fall over towards you, or towards me. Further, in consequence of the crossing of the chains the gyrostat is unstable as regards motion about a vertical axis. The arrangement is thus doubly unstable without rotation.

I now set the flywheel into rapid rotation, arrange the instrument as before, and leave it to itself, when, as you observe, it balances with great ease.

I now repeat the experiment with the chains uncrossed. Here there is only one instability without rotation, and you observe that the gyrostat falls over. An important point to be observed here is that the rotation will completely stabilise two non-rotational instabilities but not one. In point of fact, a system

possessing non-rotational freedoms, all of which are unstable, can be completely stabilised if the number of freedoms is even, but not if the number is odd.

A general explanation of the experiment just performed may be given, as follows. Starting with the bar, gyrostat rim, and chains (crossed) in one vertical plane, we may suppose the gyrostat to fall over slightly. In consequence of the tilting couple introduced the gyrostat precesses so that its axis turns in a plane which is nearly horizontal. The chains now get slightly out of the vertical, and at once a couple hurrying the precessional motion is brought to bear on the gyrostat, which, in consequence, erects itself into the vertical position. The couple does not retard but hurries the precession because the chains are crossed. This holds for both directions in which it is possible for the gyrostat to fall over. Again, suppose, starting with the rim, bar, and chain in the same vertical plane, the chains get out of the vertical. There is now a couple brought to bear on the gyrostat tending to turn its axis in a horizontal plane. In consequence the gyrostat tilts over on the bar—in other words, it has a precessional motion about a horizontal axis in the plane of the flywheel. This brings into action a couple due to gravity, which is such as to hurry the last-mentioned precessional motion; the horizontal motion is opposed and reversed, and with the reversal the gyrostat regains the upright position. This holds for both directions in which the bar tends to turn in consequence of the crossed chains. The result is complete stability.

Similar explanations are applicable to the other cases of motion you have seen.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE foundation-stone of the new building of the agricultural department at Armstrong College, Newcastle-upon-Tyne, was laid on April 5, by Dr. C. Stephenson, of Newcastle, whose gift of 5000*l.* enabled the college council to cooperate with the Board of Agriculture in a scheme proposed by the Development Commissioners. The new block of buildings has three floors, and includes administrative offices, class-rooms, laboratories for botany and zoology, a museum, research laboratories, &c.

IT is proposed to hold a short spring holiday course in science at the University of Leeds on Thursday, Friday, and Saturday, April 24, 25, and 26. The course is designed primarily for teachers who wish to keep in touch with modern scientific work, but it will also afford an opportunity for all who are interested to meet and discuss among themselves, and with members of the University staff, the problems which arise in their teaching and research. In the department of physics Prof. Bragg will give three lectures on radioactivity and its lessons, Dr. N. R. Campbell two lectures on the electron theory, Mr. A. O. Allen one lecture on modern technical optics, and Mr. S. A. Shorter one lecture on capillarity. In the department of chemistry Dr. H. M. Dawson will give three lectures on recent work in physical chemistry. The fee for the course is 10*s.*, but graduates of the University of Leeds will be admitted free.

A DEPUTATION urging the views expressed at the recent Eugenic Education Conference was received by Mr. Trevelyan, Parliamentary Secretary of the Board of Education, on April 2. Among the speakers were Major L. Darwin, president of the Eugenics Education Society, and the Headmaster of Eton. The deputation presented the following resolution, which was passed at the conference:—"That the Minister of Education be asked to receive a deputation requesting an inquiry as to the advisability of encouraging the presentation of the idea of racial responsibility to students in training, and children at school." It was indicated that there is no idea of advocating the addition of "eugenics" as an extra subject in the curriculum, or of requiring it to be taught by unwilling teachers. It was urged that if the idea of individual racial responsibility were inculcated by means of presenting the eugenic ideal, and the subject approached from the evolutionary point of view, it would both assist the teachers and tend to strengthen the moral tone of the country; and also that the training-college curriculum should be adapted to include the necessary biological and physiological knowledge on which the eugenic ideal can be based. Mr. Trevelyan expressed his sympathy with the general objects which the deputation put before him. He said the Board of Education has no wish to discourage any experiments in teaching on these lines, and recognises the importance of the matter, and will consider carefully the representations made by the deputation.

AT a meeting of the Society of Engineers (Incorporated), held on Monday, April 7, Mr. W. Ransom read a paper on how to improve the status of engineers and engineering, with special reference to consulting engineers. He pointed out that the civilisation of to-day has become possible only because of the efforts of the engineer, but that the public does not sufficiently appreciate the advantages it has gained or the men whose work has secured these advantages. Engineers have many lessons to learn from the legal and medical professions, both of which exclude unqualified men and exercise a benevolent professional control over their members; and the State should recognise the engineering profession by giving it an official standing equal to that of other professions. Admission to the profession requires to be carefully guarded, and the number of pupils allowed to an engineer should be regulated by the extent of his practice, while the climax of the period of pupilage should be a State examination. Much more may be done to make examinations of practical value to those who prepare for them, but no other form of test is possible. When State recognition is obtained for engineers, the members of the profession will constitute one great society, amalgamating the existing societies into one body, which should have the control of professional matters and be the mouthpiece of the profession. Such a society would necessarily have subsections dealing with special branches of the profession. While the growth of specialisation must be recognised, it is essential for those who are training for the profession to acquire a sound general scientific knowledge before beginning to specialise.

THE following are among the courses of advanced lectures upon scientific subjects announced in the *London University Gazette* of *April* 2:—Six lectures on the activities of plants in relation to light, at Bedford College, by Harold W. T. Wager, F.R.S., on April 28, May 5, 19, 26, June 2 and 9; three lectures on geological problems of the desert, at University College, by Dr. J. Walther, professor of geology in the University of Halle, on April 23, 24, and 25; eight lectures on surface tension and physiological processes, by Prof. A. B. Macallum, F.R.S., at the

University, beginning on May 13; eight lectures on the physiology of photosynthesis and respiration in plants, by F. F. Blackman, F.R.S., at University College, beginning on April 23; four lectures on the physiology of absorption, by Prof. T. G. Brodie, F.R.S., at King's College, beginning on May 21; four lectures on the supposed physical basis of life and mind, by Dr. J. S. Haldane, F.R.S., at Guy's Hospital, beginning on May 8; eight lectures on the factors concerned in the volume and form changes of cells (growth and movement), by Dr. H. E. Roaf, at St. Mary's Hospital Medical School, beginning on May 5; three lectures on growth and form, by Prof. D'Arcy W. Thompson, C.B., at King's College, on May 26, 28, and 30; four lectures on recent advances in the metallurgy of copper, gold, silver, and lead, by Prof. W. Gowland, F.R.S., at the Old Royal College of Science Building, South Kensington, on April 21, 25, 28, and May 2. The lectures are for advanced students of the University and others interested in the various subjects. Admission to all the lectures except those on physiology is free, without ticket.

The report of the Admiralty Committee appointed to inquire into the education and training of naval officers shows that the Admiralty policy of watching the results of its great educational experiment with the view of readjusting its procedure to meet any defects that may be revealed, is being consistently and carefully carried out. The recommendations of the Committee that are of most general interest may be thus summarised:—(1) That to increase the number of candidates for entry and so raise the standard of ability among those selected, a system of bursaries or reduced fees shall be established, which for not more than 20 per cent. of any entry would reduce the annual cost of the four years of training at Osborne and Dartmouth from about 110*l.* per annum to about 59*l.* per annum. (2) That the subsequent training of cadets in special seagoing cruisers before joining the fleet be reduced from eight months to four. (3) That all sub-lieutenants shall serve six consecutive months in the engine-room department and obtain an engine-room watch-keeping certificate. (4) That officers who volunteer for the engineering branch shall pass through a course of study lasting six months at Greenwich, followed by a practical course of about one year's duration at Keyham. (5) That for the higher technical and administrative engineering appointments at the Admiralty and dockyards a selection be made of a limited number of those who have qualified for the engineering branch. These officers will undergo a further two years' training at Greenwich, followed by not less than one year at sea, after which they will be eligible for special shore appointments, but will not be eligible to take military command. Changes in the training of specialists in navigation, torpedo, and gunnery are also recommended with the view of securing earlier practical efficiency in the duties to be actually performed at sea.

SOCIETIES AND ACADEMIES.

Edinburgh.

Royal Society, March 17.—Dr. B. N. Peach, F.R.S., vice-president, in the chair.—Dr. W. S. **Bruce**: Measurements and weights of Antarctic seals taken by the Scottish National Antarctic expedition.—Dr. S. F. **Harmer** and Dr. W. G. **Ridewood**: The Pterobranchia of the Scottish National Antarctic expedition. The paper contained the description of a new species of Cephalodiscus (*C. agglutinans*), in which the colony is massive and branching, the pieces of the colony being 115 mm. in greatest length, and 55 mm. in greatest breadth. The specimens were obtained in one haul in 56 fathoms off the Burdwood Bank, south of the Falkland Islands. The Zooids, which are deep brown or black in colour, are 4·5 mm. long, and have usually nine pairs of arms, *i.e.* a greater number than in any species hitherto known. Buds are present in large numbers, being formed in the usual way on a disc at the end of a stalk of a full-grown individual.—Prof. J. **Stephenson**: Intestinal respiration in Annelids, with considerations on the origin and evolution of the vascular system in that group. The occurrence of antiperistalsis and ascending ciliary action in the intestine of aquatic Oligochæta points to the intestine being a respiratory organ in those worms. The exceptional case of the genus Chætogaster is explained by assuming the descent of existing species (which are carnivorous) from endoparasitic ancestors, the antiperistalsis and the ascending ciliary action being given up on the assumption of the parasitic habit. From a consideration of the cryptozoic habits, the nature of the vascular system, and the occurrence of intestinal respiration, the author holds that the existing Polychæts are to be regarded as more primitive than the errant forms.—Dr. J. **Ritchie** and A. J. H. **Edwards**: The occurrence of functional teeth in the upper jaw of the sperm whale. In two of seven sperm whales examined about a score of maxillary teeth, with worn crowns, projected from the surface of the gum and were clearly used in masticating. Each of the whales had an enormous pre-oral rostrum sharply truncated at the extremity.

Paris.

Academy of Sciences, March 25.—M. F. Guyon in the chair.—Gaston **Darboux**: Minimal surfaces engendered by a variable circle.—A. **Laveran** and M. **Marullaz**: Concerning some toxoplasms of the rabbit and gondi (*Ctenodactylus gondi*). Splendore described a new protozoa (*Toxoplasma cuniculi*) affecting rabbits, and Nicolle and Manceaux have isolated a very similar organism (*T. gondi*) from the gondi of Tunis. The experiments on rabbits described by the author lead to the conclusion that the two protozoa are probably identical, although this is not yet conclusively proved.—The president announced the death of Louis Henry, correspondant for the section of chemistry.—R. **Jonckheère**: New double stars discovered at the Observatory of Lille. Since 1906 thirteen lists have been given describing the positions of 1002 new double stars of an average magnitude of 9·19.—Jules **Andrade**: New experimental researches on double spiral balance springs.—L. **Décombe**: The electronic theory of gravitation.—Mlle. Paule **Collet**: The electrical conductivity of tellurium. The direction of the crystalline axes was without effect on the resistance. The influence of pressure, of the time of passage of the current, and of the applied electromotive force has been studied, and also the residual electromotive forces in the tellurium.—H. **Buisson** and C. H. **Fabry**: The wave-lengths of the krypton lines. The krypton lines are extremely fine and permit interferences up to the order of 600,000, or even of 950,000 if the tube is cooled in a bath of liquid air, corresponding to a difference of path of 53 cm. The green and yellow krypton lines have been compared with the red cadmium line, and, taking the data given by Benoit, Fabry, and Perot for the latter, the krypton lines are evaluated as 5570·2908 and 5870·9172, with an approximation of some units in the last figure. The krypton tube has the advantage of working without heating, and the two lines can be separated with-

out the use of any apparatus for dispersion by the use of suitable absorbing solutions (didymium chloride for the yellow ray, eosin for the green ray).—M. **Dussaud**: The separation of the lighting and heating effects produced by a source of light. Instead of concentration by single lenses, a group of optical systems arranged to succeed each other automatically is used. During displacement out of the path of the rays, the system cools. In this way a separation of the heating and lighting effects is produced. Numerous applications are suggested.—Mlle. L. **Chevroton** and M. F. **Vlès**: Kinematography of the vocal chords and their laryngial annexes.—G. **Lafon**: The formation of fat at the expense of the albuminoid materials in the animal organism. The formation of fat from albuminoid material, although theoretically possible, is physiologically difficult. The nutritive value of albumin, considered as a source of energy, must be measured, not by the total energy it contains, but by the energy contained in the amount of glucose which can be derived from it.—P. **Chaussé**: The conditions of respirability of the virulent particles obtained by liquid polarisation. In experimental infection by the inhalation of liquid tuberculous virus, it is only the dried particles which are effective.—Em. **Bourquelot** and Em. **Verdon**: The reversibility of ferment actions: emulsin and β-methylglucoside. The action of emulsin upon β-methylglucoside and upon a mixture of glucose and methylglucoside shows that the reaction is reversible, the final state of equilibrium being identical in both systems.—R. **Goupil**: Researches on the phosphorus compounds formed by *Amylomyces rouxii*.—L. **Launoy** and K. **Oechslin**: Concerning secretin (Bayliss and Starling) and vasodilatine (Popielski). By repeated precipitation with absolute alcohol secretin can be obtained possessing no depressive action on the blood pressure; a depressor substance has also been isolated from the alcoholic solutions, for which the name depressine is proposed. These results are in agreement with the views of Bayliss and Starling, and opposed to those of Popielski.—Louis **Gentil**: The structure of the coast line of western Algeria.

March 31.—M. F. Guyon in the chair.—Gaston **Darboux**: Minimum surfaces engendered by a variable circle.—Emile **Picard**: A class of transcendentals generalising elliptic and Abelian functions.—J. **Boussinesq**: The existence of a superficial viscosity in the thin transition layer separating a liquid from another fluid.—MM. **Leclainche** and **Vallée**: Vaccination against anthrax. Details of a method of obtaining with certainty attenuated races of the anthrax bacillus. More than 345,000 successful inoculations have been made with this virus during the last three years.—The secretary announced the death of V. Dwelshauvers-Dery, correspondant for the section of mechanics.—M. **Amann**: Observations of the mutual occultations of the satellites of Jupiter.—Léon **Lichtenstein**: The fundamental functions of linear differential equations of the second order and the development of an arbitrary function. Application of the theory of quadratic forms to an infinity of variables.—Georges **Pólya**: A theorem of Laguerre.—M. **Barré**: A series of surfaces of which a family of lines of curvature is constituted by indeformable helices.—Henri **Bénard**: The zone of formation of alternate vortices behind an obstacle.—Ernest **Esclangon**: The motion of the support in pendulum observations.—J. **Chaudier**: The magnetic rotatory polarisation of liquefied oxygen and nitrogen.—M. de **Broglie**: The multiple images produced by Röntgen rays after traversing crystals.—Victor **Henri** and René **Wurmser**: The energy absorbed in photochemical reactions. In the three cases examined experimentally the energy necessary for the destruction of a molecule is less than the quantum of energy of Einstein.—L. **Gay**: The pressure of expansibility of normal fluids.—M. **Barre**: Combinations of cerium chloride with ammonia gas. Five definite compounds are described, all of which are decomposed by water.—A. **Saint-Sernin**: The estimation of calcium as tungstate. The determination of calcium as tungstate possesses some advantages, especially as regards its separation from magnesium.—E. **Chablay**: The preparation of the primary alcohols by reducing the esters by means of absolute alcohol and sodammonium. The ester R.CO.(OR′) is converted by this reaction into the alcohol R.CH_2.(OH). Examples of the generality of the reaction are given.—A. **Duffour**: A new crystalline form of potassium bichromate.—L. **Blaringhem**: A remarkable case of heredity in hybrids of barley, *Hordeum distichum nutans* × *H. distichum nudum*.—Albert **Berthelot** and D. M. **Bertrand**: Researches on the intestinal flora. The possible production of ptomaines in acid medium. In the intestinal flora of subjects showing symptoms of enteritis or of muco-colitis, together with fæcal matter possessing an acid reaction, an organism is frequently found (*B. aminophilus intestinalis*) capable of removing the carboxyl group from histidine even in a slightly acid medium.—M. **Mansuy**: Limestones of Indo-China containing Productus.—Gustave F. **Dollfus**: The use of drainage wells. The attempt to modify the flooding of the Seine valley by borings is useless, and likely to aggravate the trouble it is intended to alleviate.

BOOKS RECEIVED.

Paläobotanisches Praktikum. By Prof. H. Potonie and Dr. W. Gothan. Pp. viii+152. (Berlin: Gebrüder Borntraeger.) 4 marks.

Modern Geography for High Schools. By R. D. Salisbury, H. H. Barrows, and W. S. Tower. Pp. ix+418+vii plates. (New York: H. Holt and Co.) 1.25 dollars.

Der Mensch und seine Kultur. By Neophilosophos Tis. Pp. 101. (Konstanz: E. Ackermann.) 3 marks.

Theorie der Erdgestalt nach Gesetzen der Hydrostatik. By Clairaut. Edited by P. E. B. Jourdain and A. v. Oettingen. Pp. 162. (Leipzig: W. Engelmann.) 4.60 marks.

Die Druckkräfte des Lichtes. By P. Lebedew. Edited by P. Lasareff. Pp. 58. (Leipzig: W. Engelmann.) 1.80 marks.

Dispersion und Absorption des Lichtes in ruhenden isotropen Körpern. By Dr. D. A. Goldhammer. Pp. vi+144. (Leipzig u. Berlin: B. G. Teubner.) 3.60 marks.

Ministry of Finance, Egypt. Survey Department. Meteorological Report for the Year 1910. Part ii., Climatological and Rainfall Observations. Pp. 199+ii plates. (Cairo: Government Press.) 15 P.T.

Examples in Algebra. By H. S. Hall. Pp. viii+168+xxxvii. (London: Macmillan and Co., Ltd.) 2*s*.

Elementary Biology: Plant, Animal, Human. By J. E. Peabody and A. E. Hunt. (London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

Die Vererbung und Bestimmung des Geschlechtes. By C. Correns and R. Goldschmidt. Erweiterte Fassung. Pp. viii+149+plates. (Berlin: Gebrüder Borntraeger.) 4.50 marks.

Tracks of the Sun and Stars, A.D. 1900 to A.D. 37900. By T. E. Heath. Pp. 17+vi. (London: W. Wesley and Son.) 5*s*. net.

Are the Planets Inhabited? By E. W. Maunder. Pp. iv+166. (London: Harper and Brothers.) 2*s*. 6*d*. net.

The Age of the Earth. By A. Holmes. Pp. xii+196. (London: Harper and Brothers.) 2*s*. 6*d*. net.

Service Chemistry. By Prof. V. B. Lewes and

J. S. S. Brame. Fourth edition, revised. Pp. xvi+576+vii plates. (London: E. Arnold.) 15s. net.

*Canada. Department of Mines. Mines Branch. Pyrites in Canada. By Dr. A. W. G. Wilson. Pp. xi+202. (Ottawa: Government Printing Bureau.)

The Sling. By W. L. Jordan. Second edition. Pp vi+431. (London: Simpkin and Co., Ltd.) 7s. 6d. net.

Mimikry und verwandte Erscheinungen. By Dr. A. Jacobi. Pp. ix+215. (Braunschweig: F. Vieweg und Sohn.)

The Geology and Mining Industry of the Kinta District, Perak, Federated Malay States, with a Geological Sketch Map. By J. B. Scrivenor. Pp. viii+90+20 plates. (Kuala Lumpur: F.M.S. Government Printing Office.) 3 dollars.

Annals of the South African Museum. Vol. vii., part 6, pp. 353–366. Vol. xi., part 5, pp. 321–463. (London: West, Newman and Co.) 1s. and 15s. respectively.

Cours de Chimie Organique. By Prof. F. Swarts. 2e édition. Pp. 754. (Gand: A. Hoste; Paris: A. Hermann et Fils.) 15 francs.

Leçons sur les Hypothèses Cosmogoniques. By H. Poincaré. Seconde édition. Pp. lxx+294. (Paris: Hermann et Fils.) 12 francs.

Cours de Physique Générale. By H. Ollivier. Tome second. Pp. 295. (Paris: A. Hermann et Fils.) 10 francs.

Principia Mathematica. By Dr. A. N. Whitehead and B. Russell. Vol. iii. Pp. x+491. (Cambridge University Press.) 21s. net.

The Carnegie Foundation for the Advancement of Teaching. Seventh Annual Report of the President and of the Treasurer. Pp. vi+194. (New York City.)

Ministry of Finance. Survey Department, Egypt. The Geography and Geology of South-Eastern Egypt. By Dr. J. Ball. Pp. xii+304+xxviii plates. (Cairo: Government Press.) 40 P.T.

DIARY OF SOCIETIES.

THURSDAY, April 10.

Royal Society, at 4.30.—The Effect of Lability (Resilience) of the Arterial Wall on the Blood Pressure and Pulse Curve: L. Hill and M. Flack.—The Nature of the Toxic Action of the Electric Discharge upon *Bacillus coli communis*: Prof. J. H. Priestley and R. C. Knight.—Some Investigations on the Phenomena of "Clot" Formations. I. The Clotting of Milk: S. B. Schryver.—(1) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. II. The Wild Game Strain; (2) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. III. The Wild *Glossina morsitans* Strain; (3) Infectivity of *Glossina morsitans* in Nyasaland: Surg.-General Sir D. Bruce, Majors D. Harvey and A. E. Hamerton, and Lady Bruce.

Royal Institution, at 3.—Colour in Flowers: Dr. E. Frankland Armstrong.

Institution of Electrical Engineers, at 8.—Self-synchronising Machines (Self-starting Synchronous Motors and Rotary Converters): Dr E. Rosenberg.

Concrete Institute, at 7.30.—Structural Engineering: E. F. Etchells.

FRIDAY, April 11.

Royal Institution, at 9.—The Winds in the Free Air: C. J. P. Cave.

Royal Astronomical Society, at 5.—Observations of the Variable Star 97.1910 Cygni: E. E. Barnard.—A Discussion of the Empirical Terms in the Moon's Longitude: E. W. Brown.—Some Types of Prominences associated with Sun-spots: Mrs. M. A. Evershed.—*Probable Papers*: The Short Period Variable SW Draconis: C. Martin and H. C. Plummer.—Preliminary Discussion of Galactic Motions of Bright Stars of Type I, with Some Additional Material (Stellar Motions, No. 5): H. C. Plummer.—Sun-spots and Terrestrial Magnetic Phenomena, 1898–1911; Sun-spot Areas, Magnetic Storms, and the Sun's Corona: Rev. A. L. Cortie.—The Distribution in Space of the Stars of Carrington's Circumpolar Catalogue (Second Paper): F. W. Dyson.—A Suggested Substitute for Bode's Law: Miss M. A. Blagg.

Physical Society, at 8.—Some Errors in Magnetic Testing Due to Elastic Strain: A. Campbell and H. C. Booth.—Note on Kathodic Spluttering: Dr. G. W. C. Kaye.

MONDAY, April 14.

Royal Geographical Society, at 8.30.

Royal Society of Arts, at 8.—Aëronautics: Prof. J. E. Petavel.

TUESDAY, April 15.

Royal Institution, at 3.—The Heredity of Sex and Some Cognate Problems: Prof. W. Bateson.

Illuminating Engineering Society, at 8.—Standard Clauses for Inclusion in a Specification of Street-lighting: A. P. Trotter.

Royal Statistical Society, at 5.—Gleanings from the Census of Production Report: A. W. Flux.

Institution of Civil Engineers, at 8.—Coastal Sand-travel near Madras Harbour: Sir F. J. E. Spring.

WEDNESDAY, April 16.

Royal Meteorological Society, at 7.30.—The Vertical Distribution of Temperature in the Atmosphere, and the work required to alter it: W. H. Dines.—Report on the Phenological Observations for 1912: J. E. Clark and R. H. Hooker.—Meteorological, Electrical and Magnetic Observations during the Solar Eclipse, April 17, 1912: R. Corless, G. Dobson, and Dr. C. Chree.

Royal Society of Arts, at 8.—The Physical Properties of Clay: W. C. Hancock.

THURSDAY, April 17.

Royal Society, at 4.30.—*Probable Papers*: The Luminosity Curves of Persons having Normal and Abnormal Colour Vision: Dr. W. Watson.—A Fluorescence Spectrum of Iodine Vapour: Prof. J. C. McLennan.—The Relation between the Crystal-symmetry of the Simpler Organic Compounds and their Molecular Constitution. I.: Dr. W. Wahl.—The Purification of Phosphorus Pentoxide for Use in High Vacua: J. J. Manley.

Royal Institution, at 3.—The Progress of Hittite Studies. I. Recent Explorations: Prof. J. Garstang.

Institution of Mining and Metallurgy, at 8.

Royal Society of Arts, at 4.30.—The Burma Oil Fields: N. G. Cholmeley.

FRIDAY, April 18.

Royal Institution, at 9.—Applications of Polarised Light: Dr. T. M. Lowry.

Institution of Mechanical Engineers, at 8.—Presidential Address.—*Discussion*: Volute Chambers and Guide-passages for Centrifugal Pumps: Prof. Gibson.

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THURSDAY, APRIL 17, 1913.

A TEXT-BOOK OF HUMAN PHYSIOLOGY.

Physiologie des Menschen. By Prof. Luigi Luciani. Ins Deutsche übertragen und bearbeitet von Prof. S. Baglioni und Dr. H. Winterstein, mit einer Einführung von Prof. M. Verworn. Lieferung elfte-fünfzehnte. Pp. 1–782 + viii. (Jena: Gustav Fischer, 1908–1911.) Price 4 marks each.

THE present five parts complete the German version of Luciani's "Text-book of Human Physiology." The first part opens with the general physiology of sensation, giving a brief but adequate critical review of Johannes Müller's doctrine of specific nerve energies, and of Weber and Fechner's psycho-physical law governing the quantitative relationship between stimulus and sensation. The greater part of the fifty-one pages composing the first chapter is devoted to cutaneous sensations. The second chapter, occupying more than sixty pages, deals with internal and visceral sensations. While the exposition is full of detail and interest, it would have gained in clearness by a more thorough account of the classification of cutaneous and deep sensations suggested by Head and Rivers. The second chapter closes with an excellent account of the labyrinthine sensations.

The sense of taste forms the subject-matter of the third chapter, and occupies more than thirty pages. The survey given is exceptionally interesting and complete, and is well illustrated by plates. The fourth chapter is devoted to the sense of smell, and is prefaced by a brief description of the structural features of the organ of smell. The very large number of qualitative variations in odours renders the classification of olfactory sensations an almost impossible task. The author gives a very interesting and critical account of the classifications attempted by Linné and Zwaardemaker.

Nearly eighty pages are given up to the sense of hearing, which occupies the fifth chapter. It is impossible in a brief review to do justice to the excellence of the account given. The two following errors may be noted with a view to their correction in future editions. On p. 208 the word "perilymph" is used instead of "endolymph." Some confusion has also arisen in the discussion of the theory of hearing suggested by Helmholtz. In consequence, the first two sentences of the final paragraph of p. 229 require to be re-written. Fortunately, since the two sentences are obviously contradictory, there is little risk of the reader being led astray.

The sixth chapter deals fully with the dioptric mechanisms of the eye; while chapter vii. is devoted to the study of the structural features and properties of the retina, and the retinal changes concerned with vision. The description of the electromotive changes occurring in the retina as the result of exposure to light does not include the more recent results obtained by the use of the string galvanometer.

Chapter viii. contains an extremely lucid account of the movements of the eyeballs, of binocular vision, and of visual perceptions and judgments. It closes with the description of the protective and secretory mechanisms of the eyeball.

General metabolism forms the subject-matter chapter ix. The historical development of the subject is fully discussed. A necessarily brief but clear account is given of the methods employed for the estimation of the intake of foodstuffs and oxygen, and the output of solid and gaseous waste products. Chapter x. is devoted to the discussion of the regulation and measurement of heat production in the organism; while chapter xi. deals with the various theories of nutrition, and the experimental and statistical evidence upon which they are based. Chapters xii. and xiii. are given up to the physiology of reproduction. An excellent survey of the physiology of pregnancy, parturition, and lactation is given in chapter xiv.

The subjects of development, growth, maturity, and senile decay occupy the fifteenth chapter. The two latter subjects receive a much more detailed treatment than is usual in textbooks of physiology, and the whole chapter is one of exceptional interest.

The wide view of the scope of physiology held by the author is well illustrated by the final chapter, which is anthropological in nature, dealing with the characteristics of the various races of mankind from the physiological point of view. It has been contributed by Prof. S. Baglioni.

Clearly no pains have been spared to make this text-book adequate for the needs of senior students of physiology, and Prof. Luciani may well be congratulated on the completion of a textbook which may fairly be described as a colossal task for one writer. The work is well and profusely illustrated and clearly printed.

TYPICAL AMMONITES.

Yorkshire Type Ammonites. Parts i–viii. Edited by S. S. Buckman. The original descriptions reprinted, and illustrated by figures of the types, reproduced from photographs mainly by J. W. Tutcher. (London: William Wesley and Son, 1909–1912.) Price 3*s.* 6*d.* net per part, post free.

WITH the issue of the eighth part of Mr. S. S. Buckman's "Yorkshire Type Ammonites" the first volume of this important work is

brought to completion. The chief aim of this publication, as pointed out in NATURE for February 17, 1910 (p. 455), is to establish on a sound basis, by photographs of type-specimens and by critical and descriptive notes, the species imperfectly made known in the writings of Young and Bird, John Phillips and Martin Simpson. The method followed is akin to that adopted in the well-known "Palæontologia Universalis"; and in undertaking his arduous task Mr. Buckman has been fortunate in securing the collaboration of Mr. J. W. Tutcher, who possesses much experience and skill in carrying out photographic work of this kind.

The present volume happens to deal only with Liassic species, sixty-seven of which are depicted in eighty plates. The fact that no more than a single species appears on any one plate, and that the descriptive letterpress and illustrations relating to each species are issued in the form of a separate unit, will facilitate a rearrangement of the plates in any desired zoological or stratigraphical order. With the final part of the volume, which includes an index, is issued a useful measurement table designed by Mr. Tutcher. This gives a ready means for ascertaining the proportional measurements of a specimen and the amount of its enlargement or reduction in a figure.

There are several features which add greatly to the value of this work. The notes and comments which elucidate the application of certain generic names will be welcomed by many workers in this field of study. A separately paged introduction contains useful and suggestive matter under the headings "Terminology" and "Ammonite Development," where some important theoretical points are concisely handled. Generalisations regarding the cyclical development of shell-form and ornament in the evolution of the ammonite test are illustrated by a series of tables accompanied by explanatory text.

No one engaged in ammonite studies can afford to dispense with this work, which deserves generous support. It is to be hoped that the issue of the succeeding volume may not be long deferred.

TOPOGRAPHY AND TRAVEL.

(1) *From Pole to Pole.* A Book for Young People. By Sven Hedin. Pp. xiv+407+xxxix plates. (London: Macmillan and Co., Ltd., 1912.) Price 7s. 6d. net.

(2) *Highways and Byways in Somerset.* By E. Hutton. With Illustrations by Nelly Erichsen. Pp. xviii+419+map. (London: Macmillan and Co., Ltd., 1912.) Price 5s. net.

(3) *A History of Geographical Discovery in the Seventeenth and Eighteenth Centuries.* By E. Heawood. Pp. xii+475. (Cambridge University Press, 1912.) Price 12s. 6d. net.

(4) *New Trails in Mexico.* An Account of One Year's Exploration in North-western Sonora, Mexico, and South-western Arizona, 1909–10. By Carl Lumholtz. Pp. xxv+411+plates. (London: T. Fisher Unwin, 1912.) Price 15s. net.

(1) DR. SVEN HEDIN'S book, which is for young readers primarily, is conceived on no very formal lines. It is evidently intended to convey, by means of a light descriptive style, a series of impressions or mental pictures of different regions of the world, rather than to instruct in details. Naturally enough, his text is based in great measure on his own travels, and in the first and larger of the two parts into which the book is divided we find a good deal of personal narrative which cannot fail to attract youthful readers; withal it will serve an educational purpose of no little value as giving an idea of the objects and methods of scientific exploration. In this first part we are conducted across Europe from Stockholm to Constantinople, thence into Persia, India, central Asia, China, Japan, and homeward. In the second part, Africa, the Americas, the South Seas, and the polar regions are given more brie[illegible] and in truth less satisfactory, treatment, main[illegible] by means of a choice of individual salie[illegible] features for description, or isolated facts [illegible] history. There are some sketch-maps and go[illegible] photographs.

(2) Readers who know the peculiar charm [illegible] Mr. Hutton's writing on English topography w[illegible] expect much of a volume of the "Highways a[illegible] Byways" series bearing his name. They will n[illegible] be disappointed, for his volume on Somerset mu[illegible] be one of the most pleasant in the series to rea[illegible] Moreover, along with evidence of deep historic[illegible] research they will find here and there signs th[illegible] the author possesses the scientific eye for top[illegible]graphy, as when he describes the isle and vale [illegible] Avalon in their physical relationship, and discuss[illegible] the former as it may have appeared when [illegible] island in fact. Miss Nelly Erichsen's work as [illegible] illustrator is no less welcome than familiar, a[illegible] the choice of subjects seems excellent, each pictu[illegible] justifying its inclusion by its relationship to t[illegible] text.

(3) The textual standard of the Cambrid[illegible] Geographical series—which is higher than t[illegible] mechanical standard of printing and binding—[illegible] well maintained in Mr. Heawood's volume. Th[illegible]

seventeenth and eighteenth centuries in the history of exploration have been subject to a certain neglect, not unnaturally, for the century which preceded them was more brilliant than either. Students of Mr. Heawood's volume will probably find the narrative to amend their perspective (so to say), for the stream of geographical exploration flowed so full during the period that there has been some tendency to describe a few of its salient features to the total exclusion of all others. Mr. Heawood corrects this tendency: though he gives due prominence to so commanding a figure (for example) as James Cook, he also shows his work in its proper historical setting, with suitable reference to his half-forgotten predecessors (so far as he had any) and followers in the wide field over which he ranged. The book is readable and convenient for reference, and the author appears also in the *rôle* of cartographer, for several sketch-maps judiciously illustrating the salient features of early maps are by his own hand. The Cambridge series has performed a useful function in presenting certain aspects of geographical study which are not otherwise easily accessible for study in convenient form. A reference to its list will demonstrate this, and for the reason above cited the present volume would have been justifiably included in the series if on that ground only.

(4) Mr. Lumholtz offers in the volume under notice a popular account of his geographical and anthropological researches in an area of which relatively little has been known, lying about, and mainly north-east of, the head of the Gulf of California. His results in this account are introduced mainly as incidental to the narrative of his travels and experiences; we learn that he was primarily concerned to investigate "certain economic possibilities" of the region, but these do not find any important place in the book. With the inhabitants, however, he established a close acquaintance; he is able to offer by illustration and otherwise considerable insight into their life, customs, and languages, and in an appendix he furnishes a short comparative vocabulary of Papago, Pimo, and Colopa Indian words. He also treats (again with illustrations) incidentally of the antiquarian remains, the vegetation, and the fauna of the region, so that the book will, as a whole, be found to furnish a good general idea of it. There is a large-scale map which is quite effective, and, though still necessarily "sketchy," adds something to the cartographical knowledge of the area, since it embodies material not only from previous work, but also from the author's own surveys.

OUR BOOKSHELF.

Scottish National Antarctic Expedition. Report of the Scientific Results of the Voyage of s.y. *Scotia* during the years 1902, 1903, and 1904, under the Leadership of Dr. W. S. Bruce. Vol. vi., Zoology. Parts i.-xi., Invertebrates, by Dr. C. Vaney, Dr. J. Ritchie, Dr. E. L. Trouessart, Dr. W. E. Hoyle, and others. Pp. xi+353+plates. (Edinburgh: The Scottish Oceanographical Laboratory; Oliver and Boyd; Glasgow: J. MacLehose and Sons, 1912.) Price 30s.

DR. BRUCE is to be congratulated on vol. vi. of the report of the scientific results of his *Scotia* voyage, for it is very valuable in itself and reflects credit on the leader's energy and skill in organising the collecting. The volume is devoted to invertebrates, and it consists of expert reports on very interesting material. It is an important contribution to our knowledge of the antarctic fauna, and it adds some interesting material to zoological data in general. Thus we find Prof. Clément Vaney speaking of "une très importante collection d'Holothuries," Dr. James Ritchie referring to "the enormous mass of [Hydroid] material brought together by Dr. Bruce during his antarctic voyages," Messrs. Melvill and Standen defining in a supplementary collection of marine molluscs more than twenty new species, Mr. J. Wilfrid Jackson reporting that the Brachiopods collected add materially to our knowledge of the geographical range of certain forms, and augment the antarctic list of species; and so it is all along the line.

We may direct attention to Prof. Chilton's fine treatment of the Amphipods, already referred to in NATURE, Dr. Thomas Scott's important report on the Entomostraca, and to the short but interesting and scientifically cautious report on the Cestodes by Dr. John Rennie and Mr. Alexander Reid. Equally important, so far as the material went, are the reports on Acarina by Dr. E. L. Trouessart, on the Cephalopods by Dr. W. E. Hoyle, and on microscopic fauna by James Murray and E. Penard.

Le Origini Umane. Ricerche Paleontologiche. By G. Sergi. Pp. xi+202. (Torino: Fratelli Bocca, 1913.) Price 3.50 lire.

IN this useful book Prof. Sergi, of the University of Rome, gives a concise statement of the opinions he holds regarding the origin and evolution of human races. His opinions and inferences demand the most respectful consideration, for they are founded on the investigations of a lifetime, and have in every phase of his busy life been marked by an independent and courageous judgment. Prof. Sergi distinguishes five *genera* of mankind, and regards each of them as of independent origin, their relationship being represented, not as diverging branches from a common trunk, but as parallel or collateral stems issuing separately from an ancestral stock. He also regards anthropoids as parallel developments—

explaining their structural relationships to human races as inheritances from a common basal stock.

It will be thus seen that Prof. Sergi is the arch-priest of that heterodox doctrine—the multiple origin of closely allied species and genera. His faith is more robust than that of the majority of his colleagues. He accepts implicitly Ameghino's speculations concerning the independent origin of mankind in South America. Although the reviewer regards the majority of Prof. Sergi's opinions as ill-founded, he is only too willing to admit that it would be presumptuous, in the present state of our knowledge of extinct forms, to refuse them a most careful investigation.

A. K.

Vicious Circles in Disease. By J. B. Hurry. Second edition. Pp. xiv+280. (London: J. and A. Churchill, 1913.) Price 7*s.* 6*d.* net.

In the issue of Nature for May 18, 1911 (vol. lxxxvi., p. 374), an extended review by Sir T. Clifford Allbutt was published of the first edition of Dr. Hurry's book. The present edition has been revised, and six new chapters have been added in the hope of covering the ground more adequately. Most of the material of these additions has appeared already in the medical Press.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Soil Fertility.

Dr. Russell begs the whole question in two lines of his letter in Nature of January 16, when he terminates para. 7 with "the increased gain in plant growth on such highly heated soils can be largely attributed to this cause," *viz.* to the formation of ammonium and other simple soluble nitrogen compounds on heating soils to 170°.

If this were true, then the effects of heating soils, whether to the temperature of "partial sterilisation," *viz.* 98° (as in Dr. Russell's experiments) or (as in mine) to 170°, could be imitated by adding in, say, daily doses, suitable solutions containing ammonium compounds and nitrates.

I have repeatedly tried this with various combinations of salts, both in pot experiments and in the field, and have invariably found that the increased growth due to heating the soil previously was never even approached in extent by that in any of the plots or pots to which the manures were added.

It appears to me that the increased growth in Dr. Russell's experiments can only be safely ascribed to the manufacture of soluble nitrogen compounds by bacteria when in parallel sets of pots and plots the same effect is shown to be produced by artificially dosing unheated soils with such nitrogen compounds.

F. Fletcher.

Rewika Ranch, Kyambu, British East Africa, March 6.

I am not at all surprised that Mr. Fletcher failed to reproduce the conditions of a strongly heated soil by simply adding frequent doses of ammonium compounds to an unheated soil. Soil suffers considerable decomposition when heated to 170° C., and changes markedly in chemical composition, physical properties, suitability as a medium for the growth of bacteria, moulds, and other organisms, and as a habitat for the higher plants. Experiments become extraordinarily difficult to interpret when so many factors change simultaneously, and for this reason I have always preferred to adopt very much milder methods, treating the soil with antiseptic vapours (*e.g.* toluene), or heating to as low a temperature as possible (60° to 95° C.). Here less complication arises, because the decomposition effects are at a minimum, and one can study the various factors one at a time.

Increases in productiveness equal to those brought about by treatment with antiseptic vapours or heating to 65° C. can be obtained on our normal untreated soils by additions of sodium nitrate or ammonium sulphate. Further, partial sterilisation has failed to bring about increased productiveness when the treated and untreated soils are subsequently so liberally treated with nitrogenous plant food that the nitrogen supply is no longer a limiting factor. In "sick" soils, however, there is another limiting factor, the presence of disease organisms and pests, and this also is put out of action more or less completely by partial sterilisation. Here addition of nitrogenous plant food (which leaves the pests unaffected) does not make the untreated soil equal in productiveness to the partially sterilised soils. We could get no evidence of the toxin suggested by Mr. Fletcher, and, this being the case, I do not see how we shall advance matters by assuming its presence as a third limiting factor.

E. J. Russell.

Rothamsted Experimental Station, Harpenden.

Induced Cell-reproduction in the Protozoa.

I was interested in Mr. T. Goodey's letter under the above heading in Nature of March 13, but should like to make a few remarks thereon. Hay infusion, which Mr. Goodey states caused the excystation of *Colpoda cucullus*, is prepared from dried grass, and here we have the products of cytolysis, and, in consequence, should expect the presence of auxetics. As a matter of fact, any vegetable infusion contains auxetics, the presence of which can be demonstrated by the jelly method on human lymphocytes, as described by Dr. H. C. Ross, "Induced Cell Reproduction and Cancer" (London: John Murray, 1910). Encysted forms of Colpoda cannot be compared with the winter spores of Polytoma, as in Colpoda there is, so far as I can gather from Mr. Goodey's letter, no conjugation prior to the encystment, and consequently no real development is necessary for the excystation, but only rupture of the cyst-wall. In Polytoma, however, the cytoplasm within the spores has to undergo several complex changes, leading ultimately to division of sarcode, formation of envelopes round the products of division, and the development of flagella. Thus, I take it that in Colpoda there is no reproductive process in the excystation, and consequently no necessity for auxetics; anything that will cause the rupture of the cyst-wall being sufficient, although, as already shown, auxetics were certainly present in the hay infusion.

With regard to the "pure distilled water," Mr. Goodey should remember that this is pure only so long as he adds nothing else to it. Directly organisms are added, auxetics would be present, as, apart from the fact that some of the culture fluid would be introduced with the organisms, even if this were not so, auxetics would be present, as there would be necessarily some death-rate. The same phenomenon also occurs in pond Amœbæ, the encysted forms of which can also be caused to undergo excystation by incubation with distilled water.

Whether auxetics are necessary for any form of cell-reproduction to occur is a point which will require further research to determine. It is, however, a striking fact that Dr. H. C. Ross was able for the first time to induce divisions in human leucocytes by means of auxetics, and was also able to demonstrate that the ova of *Ascaris megalocephala* will undergo division if incubated with auxetics. Dr. Fansham has also shown that *Entamoeba coli* can be caused to divide through many generations by means of these substances, whilst Dr. E. H. Ross has demonstrated that auxetics have a very remarkable action on trypanosomes.

From the foregoing facts it is clear that auxetics are *a cause* of cell-reproduction, and, although we cannot as yet state positively that there are no other causes, yet, judging from other biological examples, it is extremely probable that they are the sole cause, as it is very unlikely that a complex function like cell-reproduction should have more than one direct cause. With regard to the presence of auxetics and kinetics in pond water, I may say that I am at present investigating this point, and have definite proof of the presence, not only of auxetics, but also of kinetics or augmentors, in such waters, the latter bodies apparently varying according to the season, and also being dependent on the amount of albuminoid ammonia present.

Besides the presence of auxetics in hay infusion, there is one further point to be mentioned, viz. that if by the action of an enzyme, the cyst-wall in Colpoda were dissolved, quite enough auxetic would probably be liberated to cause division, were such necessary for development. This was well shown by Dr. H. C. Ross, who found that substances not themselves auxetics may yet have auxetic action by causing limited cell death immediately within the walls of ova, thus setting free enough auxetic to cause cell-division.

Aubrey H. Drew.

69 Ewhurst Road, Crofton Park, S.E.

Units of Pressure in Vacuum Work.

Referring to the letter by Mr. Shaw in Nature of March 20 (p. 95), I beg leave to remind readers that we have already a convenient unit of pressure which, as fitting in an absolute system of units, is preferable to the micron of mercury, viz. the dyne per cm.^{2}, or the barye of the c.g.s.-system. In fact, Prof. Knudsen has used it in all his later researches on molecular phenomena. In article V10 of the "Encyklopaedie der mathematischen Wissenschaften," p. 628, note 19 (Communications from the Physical Laboratory at Leyden, Suppl. No. 23, p. 14), by Prof. Kamerlingh Onnes and myself, we have given practically the same unit under the name of *millitor* as convenient for such pressures as those in Röntgen vacua.

In doing this we have followed the lead of the Commission of the International Association of Refrigeration (*Bull. de l'Ass. internat. du froid*, 2, 1911, p. 38, rapporteur M. Ch. Ed. Guillaume). This commission proposed to accept the metre-kilogramme-second system for general use, this one having better chances than the c.g.s.-system, and accordingly to introduce as an absolute unit of pressure the m.k.s.-unit. As a practically identical realisation of it the commission proposed to introduce the *international centitor* (abbreviated for centi-torricelli), the international kilotor being equal to the pressure of a column of practically 75 cm. of mercury under normal gravity (for further particulars see the article quoted above). Practically 1 millitor = 1 dyne/cm.^{2}, or barye, and within the accuracy of experiments in the domain of these vacua 1 millitor = $0{\cdot}75\ \mu$ of mercury.

Seeing how simple this proportionality factor is, the work of reducing, say, McLeod gauge readings to millitors will not cause any appreciable trouble, whereas the indications by Prof. Knudsen in dynes/cm.^{2} are without any reduction expressed in millitors. For the highest vacua the *microtor* = 10^{-3} millitor = $0{\cdot}75 \times 10^{-6}$ mm. of mercury would be convenient. As abbreviations, mtor may be written for millitor, μtor for microtor.

W. H. Keesom.

Physical Laboratory, Leyden.

Reflection of X-Rays and X-Ray Fringes.

Accounts of the reflection of X-rays and of X-ray fringes contributed to Nature by Messrs. Bragg, Moseley, Barkla, Hupke, Keene, and others induce me to send you some results that I have obtained recently in the same direction.

I think that the appearances observed by Messrs. Laue, Friedrich, and Knipping are really due to the same cause as the reflected spots; they present quite a similar distribution and general character.

Fig. 1 shows the pattern obtained with a beam of Röntgen rays falling at an incidence of 80° upon a face of a cube of rock-salt, the photographic plate being at right angles to the reflected beam. The reflected spots are similar to the transmitted spots, and present fringes perpendicular to the plane of incidence; they are situated on an elliptic curve, to which belongs also the point of impact of the primary beam. The spot on the main axis is regularly reflected; the others are symmetrically disposed, and possibly due to reflection on the planes of the corresponding octahedron, dodecahedron, &c., which are in suitable positions. Fluorine gives the same pattern.

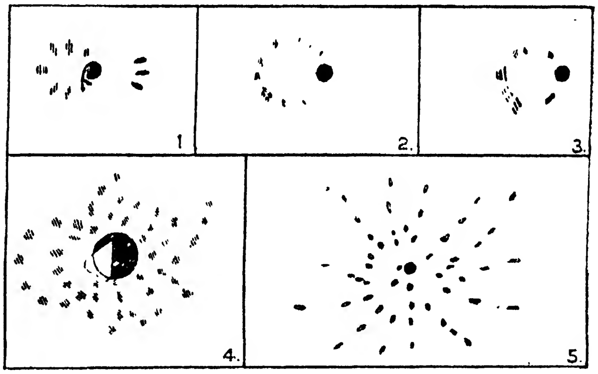

Fig. 2 is obtained with a beam (incidence 80°) falling upon the triangular face of an octahedric crystal of magnetite. The reflected spots show two systems of fringes, one of which is approximately perpendicular to the plane of incidence.

It seems of importance to pay attention to the angle between the intersection of the plane of incidence and the quaternary axis situated in the cubic face of reflection. Fig. 3 shows that when this angle (which was 0 in Fig. 1) becomes 45°, the curve of spots is deflected, the regularly reflected spot being no longer on the main axis but following the ordinary law of reflection; the distance of the fringes is probably slightly changed in this case.

I have often observed fringes in the transmitted spots obtained by Laue's methods. With octahedric magnetite (Fig. 4) all the spots (more than 100) were striated by parallel fringes; and on a plate (Fig. 5) obtained with fluorine the transmitted spots, the number of which was also very large, are all doubled in a radial direction.

I may add that one obtains quite similar phenomena with ordinary light and two ordinary (200 lines per millimetre) gratings, when the incident beam forms similar angles of incidence with the plane of the gratings.

M. DE BROGLIE.

Increase of Definition in a Moving Telescope.

I HAVE received several suggestions, for which I wish to express here my indebtedness, as to the probable explanation of the increase of definition in a moving telescope, referred to in my letter in NATURE of March 27. They are chiefly based on the principle of "contrast" as described by Mr. G. W. Butler in NATURE of April 10, but Mr. W. H. Robinson, of Oxford, attributes the increase of definition to "averted vision," by which a faint source of light is better seen if the eye be directed a little on one side of it. This, at first, seemed to me the correct explanation, the more satisfactory that it involves but a well-known physiological property of the eye. By moving the telescope the object is continually eluding the eye, and visibility by continuous unconscious "averted vision" would be the result. I, however, satisfied myself that there must be some other cause, as a *deliberate* use of "averted vision" failed entirely to show me the time-ball when I tried it after receiving Mr. Robinson's letter, while I noticed that, as soon as the sweeping motion had begun, it was plainly visible by *direct vision,* my eye following it all the time. Mr. Butler's suggestion seems therefore more plausible, although less definite.

M. E. J. GHEURY.

Woolwich Polytechnic, April 15.

THE NINTH INTERNATIONAL CONGRESS OF ZOOLOGY AT MONACO.

THE ninth International Congress of Zoology terminated its session under the presidency of his Serene Highness the Prince of Monaco at Monaco on Saturday, March 29. Altogether, the meeting was an unqualified success, not only on account of its numbers, which, as already stated, were greater than on any previous occasion, but also for the general interest of the contributions, which, although no single one can be selected as absolutely outstanding, were all of very high quality, and demonstrated the result of much serious and useful work by zoologists during the past three years. The beauties of the Côte d'Azur doubtlessly attracted many from northern lands, and although the weather was not all that could be expected for the Riviera at this season, yet the rather copious rainfall settled and washed away the dust and refreshed the herbage, which was the more brilliant during the intermittent periods of bright sunshine. The chief attraction, however, was the noble Oceanographical Museum, which crowns the cliffs of the rock upon which the town of Monaco with its palace is situated, and the fact that the congress was to hold its chief meetings within its precincts, with its founder as their president.

The opening reception in the museum, the holding of many of the meetings of the congress within its walls or only across the other side of the road at the Lyceum, and the fact that members were entitled to visit all its galleries and its aquarium at any time during the whole congress enabled everybody to become thoroughly acquainted with the museum and its interesting collections. Since its opening in 1910 there have been great developments and additions, thanks to the indefatigable energy of Dr. Jules Richard, its able director, and his assistants. A very full account of the museum was given soon after its opening in the columns of NATURE by Mr. J. Y. Buchanan; it is not, therefore, necessary to repeat what he has said, but since that time there have been many developments, and among others the opening up of a large new gallery in the western wing of the building. Zoologists were especially delighted, not only in seeing the excellent cetacean collection—whales mostly captured by the Prince himself—but also the really marvellous collection of well-mounted deep-sea fishes, which were familiar to many as figures, but the original specimens of which they now saw for the first time, and the same may be said of the invertebrates. A particularly useful and instructive arrangement is that side by side of each specimen is placed, where possible, the original painting of the animal taken from the fresh specimen, or the reproduction of such a coloured drawing as presented in the unique plates appearing in the Prince's publications. This is specially valuable, since it is impossible to preserve the original colours of animals in alcohol and because a better idea of the form of the fresh animal is given.

Besides the Prince's collections were also shown the first fruits of exchange with outside collections, and notable among these was a case containing many of the deep-sea and shallow animals taken by the *Scotia*. There is also a well-mounted case of penguins taken by the French Antarctic Expedition, as well as seals, birds, and eggs taken by the *Scotia* in the antarctic regions.

The collection of instruments and various forms of fishing appliances, nets, trawls, dredges, traps, hooks, &c., used not only for scientific but also for economic fishing, was also a source of attraction, and not least of all the aquarium with its wonderful living forms of Mediterranean fishes and invertebrates, each more wonderful than its neighbour, and which only those who had previously visited such stations as Villefranche and Naples had seen before, but were more than ready to see again.

Some days before the opening of the congress many zoologists made their appearance, and on Monday, March 24, practically the complete roll of 723 members, including more than eighty British representatives, was signed, and members had received their insignia, cards, and papers. On Tuesday afternoon there was a meeting of the permanent committee for the election of vice-presidents of the congress and presidents of the sections, Lord Walsingham being chosen first vice-president. At 6 p.m. the congress was formally opened by the Prince, who, dressed in the official uniform of the Institut de France, delivered his inaugural address. The president

was supported by the delegates of twenty-four Governments, the only Government not being officially represented being the British Government; very appropriately, however, the Prince recognised Lord Walsingham, one of the trustees of the British Museum, as the official representative of Britain.

In an eloquent address the Prince suggested that by their meeting at Monaco, zoologists marked the importance of the study of marine animals, that they conceived that marine zoology possessed the principal elements necessary to elucidate the history of life and the origin and evolution of its different forms. They had considered this temple of oceanography worthy of an assembly which dealt with these subjects. These congresses, he said, should be encouraged because they brought about a *rapprochement* of men of all shades of opinion from countries representing occupations of intelligence. They measured the force of production of different human communities, and gave young people an opportunity of associating rapidly with the general progress of ideas. The study of zoology was of the greatest significance, because it dwelt upon the history of life, effacing illusions of ignorance. Above all, the study of marine zoology was precious in relation to the investigations of the origin of life. He believed that the ocean was the origin of life, and that there was ancestral colonisation from the waters to the land. The Prince emphasised that, in the study of oceanography, it was important to investigate the regions that lay above the surface of oceans; hence his investigations of the higher atmosphere. Finally, he asked the congressionists before leaving the old rock of Monaco, still scarred by old buildings which marked the law of force, to consider well the edifice constructed to arbitrate in favour of science. Below was the savage instinct which was now surmounted by progress, time giving dominion to creative force over the vain rivalries of man. He emphasised how these developments had taken place in a country long protected by peace.

The Prince was followed by Dr. Perrier, director of the Natural History Museum of Paris, the eminent president of the permanent commission of the congress. Dr. Perrier dwelt on the importance of oceanographical research to zoology, paid well-merited eulogy to the Prince for his great and lifelong services to oceanography and zoology, and also to the epoch-making work of Guyon, Jeffreys, Wyville Thomson, and William Carpenter. In the evening there was a reception given by the president in the museum, which gave the first opportunity of congressionists meeting each other and discussing various matters of common interest—a feature, indeed, which is perhaps, after all, the great result of all such meetings, for one hears of some fellow man of science and one knows something of his work, reading much perhaps that he has published and probably having also corresponded with him, but now for the first time one meets him face to face, discusses knotty points to the immense advantage of each, often clearing away misunderstandings and sealing a bond of friendship. This was especially the case at Monaco regarding the long discussion on nomenclature.

More than 150 papers were given by different authors, and most of these were given in abstract, in many cases being illustrated by lantern or kinematograph. Time, however, curtailed many authors, and compelled others to have their contributions held as read. British zoologists were on this account deprived of hearing Prof. Ewart give an account of the new zoological gardens to be opened in July in Edinburgh by the Zoological Society of Scotland, which promises to be one of the finest, if not the finest, zoological garden in Europe.

Among British contributions was one by Prof. Elliot Smith, of Manchester, who gave an account of the homologies of the cerebral cortex in vertebrates. Prof. J. Arthur Thomson, of Aberdeen, gave an important communication on Alcyonarians recently collected by H.S.H. Prince Albert I. of Monaco, illustrating his remarks by a series of finely executed paintings which are to form the plates of his monograph. Mr. G. P. Mudge, of the London Hospital Medical College, gave an interesting communication on some problems of hybridisation, whilst Dr. Scharff, of Dublin, gave a paper on zoogeography, giving an account of his most recent researches in a subject to which he has devoted so much attention with such excellent results. Prof. Hull, late director of the Geological Survey of Ireland, discussed recent discoveries in the physical features of the North Atlantic Ocean, as confirming the view of the distribution of European animals by land connection in Tertiary times.

Dr. W. S. Bruce, of Edinburgh, summarised the zoological results of the *Scotia*. He pointed out that the leading feature of the *Scotia's* work was her investigations in great depths in high southern latitudes by means of trawl and vertical plankton net. The percentage of new species taken in great depths down to 2645 fathoms was very high. Out of about a thousand *Scotia* species described more than 25 per cent. were new to science. The zoological researches of the Scottish naturalists disproved bipolarity, those species which had a bipolar distribution having also universal distribution. They tended also to show that antarctic fauna was not circumpolar, at least to the extent that arctic fauna was, but that it was subdivided into regions, which appeared to be associated with the south polar "deeps" separated by those "rises" which probably indicate former connections of Antarctica with the more northern continental land masses.

The Indian Museum, Calcutta, accounted for a goodly number of interesting communications. Dr. Nelson Annandale gave an important paper on the African element in the fresh-water fauna of India. He showed there was a strong affinity,

extending even to species in some cases, between fresh-water sponges, Hydrozoa (Limnocnida), and Polyzoa of India and of tropical Africa. In some instances this affinity extended to South America. The same phenomenon existed in other groups, and indicated former land connection. So far as the invertebrates were concerned, there was little evidence of any African element in the aquatic fauna of the Jordan valley, although many African fishes are found in that district. The difference between the African element in the fresh-water fauna of India and that in the fresh-water fauna of Palestine is probably due to the fact that the geographical connection was broken at a comparatively early date in the case of India, and that the climate and the composition of the water of the Jordan at present differ greatly from those both of India and Africa. Captain R. B. Seymour Sewell, I.M.S., surgeon-naturalist to the Indian Marine Survey, gave a communication on the post-larval development of the Copepoda. The collections on which these observations were based were from three estuarine regions on the coast of Burma and Bengal. In their post-larval development the Copepoda follow Brooks's law, and under suitable conditions apparently may be dimorphic in both sexes, thus resembling Amphipoda and Ostracoda.

Prof. Roule, of Paris, described a new species of abyssal fish, to which very great interest is attached, because it was captured by the Prince of Monaco in the great depth of 6035 metres, a depth in which no fish had previously been caught. Prof. V. Dahlgren, of Princeton, gave an account of his recent researches in a remarkable polarity in the motor nerve cells of the electrical apparatus of *Tetronarce occidentalis*. Prof. Th. Mortensen, of Copenhagen, described a new genus and species of a sessile Ctenophore, upon which Prof. Ziegler, of Stuttgart, made some important comments. Miss Foot and Miss Strobell, of New York, showed the results of crossing three Hemiptera species with reference to the inheritance of an exclusively male character. Prof. J. Petersen, of Copenhagen, gave a paper entitled "Determination of the Quantities of Animal Life in the Sea: its Communities and their Geographical Value." Prof. C. Wardell Stiles, of Washington, gave an account of the distribution of *Nector americanus* in the United States, its medical and economic importance, and the campaign for its eradication. This formed one of a series of important papers on applied zoology.

Dr. Jacques Liouville, of Paris, emphasised the importance of constructing a faunistic chart of the antarctic regions, especially in relation to the continental shelf. His suggestion was specially supported by Prof. J. Arthur Thomson, who thought Dr. Liouville should be thanked for taking the initiative in this matter. Mr. Heron-Allen and Dr. Bruce also supported the suggestion. Dr. Liouville suggested taking up the French section, and Dr. Bruce agreed to take the Scottish section, suggesting that others should similarly be asked to join, and further that the president of the congress should be asked for his patronage, and also be requested to allow the publication of the chart to appear in his publications. This was afterwards further approved of in the general section.

M. Henri Bourée gave two kinematograph and colour photograph lantern demonstrations, illustrating the work of the Prince and his staff on board the *Princesse Alice*. The series of pictures is excellent in every respect, the colour pictures of animals being exquisite, and the kinematograph pictures showing sounding, trawling, fishing, and whaling operations being most instructive.

The subject of zoological nomenclature played a large part in the proceedings. It had been feared that there might be a battle royal between the advocates and opponents of the law of priority, carried out to the bitter end, but happily preliminary discussions of a more or less informal kind led to the adoption of a *via media*. A resolution was adopted which empowered the nomenclature commission to suspend the rules in cases where it would cause great confusion to carry them out. This power is, however, safeguarded by such stringent conditions that there is no fear of its being used except in very urgent cases. Prof. Brauer opened the discussion on nomenclature, presenting the well-known views of the German Zoological Society, and was followed by the Hon. Walter Rothschild and Dr. Hartert, of Tring, M. Oberthur, of Rennes, Prof. E. Ziegler, of Stuttgart, Prof. S. W. Williston, of Chicago, Prof. Fauvel, of Angers, Prof. Th. Mortensen, of Copenhagen, Lord Walsingham, of the British Museum, Dr. Hoyle, of Cardiff, Dr. J. A. Allen, of New York, and Dr. Ch. Wardell Stiles, of Washington, the secretary of the permanent committee.

In proposing a resolution "That an international commission on entomological nomenclature be appointed, whose powers and authority shall be equal to those of the existing commission on zoological nomenclature, and who shall report their decisions and recommendations annually to the Zoological Congress," Lord Walsingham emphasised that the principal object of zoological nomenclature was to give to all zoologists the means of acquiring and imparting information about the subjects of their studies. The aim should be to establish an accepted system ensuring simplicity and finality in nomenclature. This had to be attained on the basis of the law of priority. He supported Dr. Ernst Hartert against certain proposals put forward by the German Zoological Society which, if adopted, would be fatal to any attempt to obtain uniformity or finality in nomenclature. The first principles of the law of priority must be adhered to. Let revision be gradual, and proceed on well-considered lines, subject to the final authority of the International Zoological Congress, acting on the recommendations of its two equal commissions—that of general zoology and that of entomology.

The Hon. Walter Rothschild emphasised the point that any society or individual proposing such an important change as that proposed by the German Zoölogical Society ought, if they wanted serious consideration at all, to put their meaning in absolutely clear and unequivocal language. He stated that the time quoted, "twelve" years, as being sufficient to judge of the need of the "law of priority" was absurd, as it would take at least two generations for the law in question to settle nomenclature in general, and at least one generation before we could judge of its effects. Mr. Rothschild also stated that a progressive list of exceptions to that law, namely, one to be augmented from congress to congress, would lead to utter chaos. He was opposed to any exceptions whatever, but would be willing to see, in cases where confusion was likely to arise, that names for a long time employed for one genus or species, and which under the rules must be transferred to another, should be dropped altogether, and that names differing only in one letter from any already in use should be treated as inadmissible. He was also in favour of using larval names, and those founded on a single phase only, being used in that sense only, and not under the law of priority used for the adult in another phase.

Finally, it was resolved—that plenary power is herewith conferred upon the international commission in zoological nomenclature acting for this congress to suspend the *règles* as applied to any given case, where in its judgment the strict application of the *règles* will clearly result in greater confusion than uniformity, *provided,* however, that not less than one year's notice shall be given in any two or more of the following publications, namely, *Bulletin de la Société Zoologique de France, Monitor Zoologica,* NATURE, *Science* (N.Y.), and *Zoologischer Anzeiger*; that a question of the possible suspension of the *règle* as applied to such cases is under consideration, thereby making it possible for zoologists, particularly specialists in the group in question, to present arguments for and against the suspension under consideration; and *provided* also that the veto of the commission is unanimously in favour of suspension if not less than two-thirds be present. The commission is hereby instructed to report the facts to the next succeeding international congress.—It was also resolved "That the congress fully approves of the plan that has been inaugurated by the commission of conferring with special committees from the special groups involved in any given case, and that it authorises and instructs the commission to continue and extend their policy." Altogether, the conclusions arrived at appear thoroughly satisfactory, especially as the plenary power of the commission is very adequately safeguarded.

The invitation of the Government of Hungary to hold the congress of 1916 in Budapest was accepted, and Prof. Hovarth, of Budapest, was elected president.

THE INTERNATIONAL CONGRESS OF HISTORICAL STUDIES.

THE members of the International Congress of Historical Studies have been holding their meetings in London, under the presidency of Mr. James Bryce, who was, however, unfortunately absent throughout the proceedings. Five years ago, the congress held very successful meetings in Berlin, and ten years ago it assembled under favourable auspices in Rome. If the London meeting has attracted less notice in the country of its assembling than the two preceding ones, it has none the less produced some excellent papers, and it must be accounted a real loss to the general public that the very faulty organisation of the congress, combined with our insular aloofness and the ignorance of modern languages which is an accepted item of English education, has prevented the meetings from receiving their due share of attention.

The congress has covered so large a field of historical studies that any general survey of its deliberations would be impossible in this place. It has discussed the philosophy of history and the history of historical studies, while other sections have met daily to exchange views on Egyptian, classical, Byzantine, and Oriental history, as well as on matters pertaining to military, naval and colonial, religious and ecclesiastical, legal and economic, mathematical and scientific, studies.

The President of the Board of Education (Mr. J. Pease) directed attention to the frequent connection that has existed in England between history and politics, citing the names of Clarendon, Gibbon, and Macaulay, and, at the present time, of Bryce and Trevelyan. The advantages of such a connection may perhaps be questioned. From it has resulted the habit of treating history as a branch of politics rather than of considering politics as a department of history. The current text-book treatment of the English civil war and the American revolution—to give but two instances—has probably suffered much in its accuracy from the fact that the principal English historians have been primarily Whig politicians. To the popular conception of the politician as the sufficient and efficient historian, we may perhaps attribute the neglect by successive Governments of the marvellous series of records—the admiration and envy of other European nations, and the best material for history—which belong to this nation. No one knows better than Prof. C. H. Firth, who dealt with the subject of English records, how badly kept, how inaccessible, how uncalendared, are a great proportion of our English public documents.

It was entirely characteristic of the English politician-historian that, at the Oxford dinner, Lord Morley of Blackburn should warn his hearers against laying too much stress on research in diplomatic archives and parish registers, and should remind his audience that, fortunately or unfortunately, sentiment and prejudice have had far more to do with the making of history than reason and precedent.

The president's address, read in his absence by Dr. A. W. Ward, of Peterhouse, contained references to the importance of recent discoveries regarding the early Mediterranean civilisations, and laid stress on the value of modern critical ethnology for the correct understanding of the foundations of present-day movements in Europe; while Mr. D. G. Hogarth's paper on Hittites and the Hittite civilisation showed that a beginning has been made in attacking an outstanding problem bearing on the same subject. Prof. E. Bernheim spoke of history as a record of the variation of intellectual viewpoint at different epochs of time. Prof. von Gierke dealt with the evolution of the idea of the right of a numerical majority to control the government of a country. Prof. Pirenne gave a suggestive account of the stages in the growth of capitalism from the twelfth to the nineteenth centuries, and described the change from mere subsistence industry and husbandry to the creation of capitalism as an engine by which the advancing intelligence can obtain an increase in knowledge, in material resources, and in control over the forces of nature.

In the subsection devoted to the exact sciences, natural history, and medicine, papers were read by Sir Clifford Allbutt on Palissy, Bacon and the revival of natural science; by Prof. Loria on mathematics in Great Britain; by Prof. Silvanus Thompson on the history of the compass card; by Prof. H. H. Turner on Aristarchus of Samos, and by Mr. Rouse Ball on Newton's Principia and also on magic; Dr. Norman Moore gave an account of the Royal College of Physicians, Prof. L. C. Miall illustrated seventeenth-century research by the life of Peiresc, and Mr. W. C. D. Whetham read a paper on the historical method in natural science.

PUBLIC VETERINARY SERVICES.

A DEPARTMENTAL Committee on the Public Veterinary Services was appointed last August by Mr. Runciman to inquire into the requirements of the public services with regard to the employment of officers possessing veterinary qualifications, and to consider whether any further measures can with advantage be adopted for the selection and training of students with a view to such employment. The committee, the report of which has recently been published (Cd. 6575), consisted of Sir A. Hopkinson (chairman), Sir T. H. Elliott, Sir T. W. Holderness, Mr. H. J. Read, and Major G. F. MacMunn. In October Sir T. W. Holderness resigned, and Mr. F. C. Drake succeeded him.

In all twenty-one witnesses were examined, together with a number of written statements of representatives of self-governing Dominions and universities who for various reasons were unable to attend in person. Evidence was given on behalf of the Departments employing veterinary officers, viz., the Colonial Office, India Office, War Office, and the Board of Agriculture and Fisheries; also on behalf of the five veterinary colleges, the examining and diploma-granting body (the Royal College of Veterinary Surgeons) and various British universities.

After considering the present system of veterinary education, the committee is of opinion that the standard appears sufficient for the purposes of private practice, but not for the public services, for research and administrative work. The army veterinary department has no difficulty in finding suitable candidates, and, moreover, the first two years of the young officer's service are devoted to the improvement of his education, and to training him for his future work.

The demand for the other public services of veterinary officers has increased, and will almost certainly increase still further. Already great difficulty has been encountered in procuring suitably trained men for the posts, alike at home, in the Colonies, and in India. The most important steps to be taken to improve the quality and quantity of candidates are (1) to encourage a larger number of young men who have continued their general and scientific education beyond secondary-school age to enter the veterinary profession; (2) to provide for men who have qualified as veterinary surgeons increased facilities to extend their knowledge, more especially in the direction of specialisation in one branch of veterinary science; and (3) to improve the system of notifying vacancies.

With these objects in view the committee recommends that: Students possessing a suitable science degree should be exempted from one of the four years at present required for veterinary qualifications; that twelve scholarships should be offered each year of the annual value of 80*l.* each, tenable at a veterinary college for three years, with a view to encourage a number of men who have received a good scientific education to enter the veterinary profession; scholarships of an annual value of not less than 100*l.* and not exceeding 150*l.* should be offered each year to enable qualified veterinary surgeons to undertake advanced study and laboratory work at suitable institutions at home or abroad, where special facilities for such studies exist. The committee further recommends that increased State aid should be given to institutions devoted to veterinary education, the efficiency of which is of great importance to the State. It is of opinion that the Royal College of Veterinary Surgeons "is performing a work of great national importance, and that its efforts to maintain a high standard of veterinary education in this country are worthy of every encouragement."

NOTES.

THE International Congress of Zoology at Monaco and that of Geography at Rome are over, but another interesting meeting of representatives of the nations took place on April 5, at the Zoological Station, Naples. The occasion was the unveiling of a memorial tablet to the illustrious founder of the station, Prof. Anton Dohrn. The tablet, in bronze, which has been fixed above the fountain on the north side of the

central court between the two great laboratories, was unveiled by Prof. von Graff, who spoke on behalf of the International Zoological Congress, at the meeting of which at Graz it was decided to erect and place within the station a monument to the late Anton Dohrn. Von Graff, in his appreciation of Dohrn's work, referred more especially to the international character which the station has developed under the distinguished direction of its founder. The tablet having been unveiled, Prof. Todaro, of Rome, an old personal friend of Dohrn's, spoke on behalf of the Accademia dei Lincei and the Italian Department of Public Education. Dr. Wever, Consul-General for Germany in Naples, made a speech representing the Foreign Office and the Department of Public Education in Berlin. Marchese del Carretto, Mayor of Naples, spoke of the advantages enjoyed by the town from the aquarium and marine station, and Admiral Raggio Ducarne referred to the connection between the Italian Navy and the zoological station. Wreaths were placed at the base of the monument by the speakers mentioned, and by many of the delegates. After a speech by Prof. Reinhard Dohrn, son of the late Anton Dohrn, and now director of the station, the ceremony concluded.

WE regret to see the announcement of the death, on April 14, of Herr Karl Hagenbeck, the owner of the famous zoological park at Stellingen.

THE death is announced, at forty-eight years of age, of Mr. Percival Spencer, the well-known balloon manufacturer and aëronaut, who made many notable journeys by balloon, and was closely associated with developments of aërial navigation.

AT the annual general meeting of the Selborne Society, to be held in the theatre of the Civil Service Commission, Burlington Gardens, W., on Monday next, April 21, there will be an exhibition by Mr. John Glen of the portrait recently discovered which claims to be that of Gilbert White.

THE death is announced of Prof. V. Dwelshauvers-Dery, correspondant of the Paris Academy of Sciences, in the section of mechanics, and of M. Louis Henry, correspondant in the section of chemistry. Prof. Dwelshauvers-Dery was born at Dinant in 1836, and studied engineering at Brussels and Liège, obtaining his degree as doctor of physical sciences at the latter place in 1861, where he afterwards took charge of the course of applied mechanics, and established a laboratory. He gave particular attention to the study of steam engines.

SIR EDWARD T. CANDY, formerly judge of the Bombay High Court, whose death at Great Shelford, near Cambridge, on April 13, in his sixty-eighth year, is announced, took an active share in the work of the Bombay University, and was Vice-Chancellor for five years (1897–1902). He was chairman of the provisional committee of the Indian Research Institute now established at Bangalore through the munificence of the late Mr. J. N. Tata. On his retirement in 1903 he settled at Great Shelford, and he took a keen interest in the affairs of Cambridge University.

A PIONEER in telegraph engineering has been lost by the death, at the age of eighty-two, of Mr. E. B. Bright, on April 14. From an obituary notice in the Engineering Supplement of *The Times* we learn that with his young brother, afterwards Sir Charles Bright, he joined the Electric Telegraph Company in 1847. Within a year of entering this new field both became inventors. Perhaps the most important of their early inventions was the system, devised in February, 1849, of testing insulated conductors to localise faults from a distant point, by means of a series of standard resistance coils of different values, brought into circuit successively by turning a connecting handle. In 1851 Charles left the Electric Company, and shortly afterwards became engineer to the British Telegraph Company, while Edward joined the Magnetic Telegraph Company, of which, in 1852, when only twenty-one years old, he became manager. The brothers soon found it necessary to devise fresh apparatus to compensate for the inductive discharge resulting from the long underground circuits by discharging to earth and thus neutralising the recoil currents. From that time until the spring of 1854 they carried out a series of experiments on the great lengths of subterranean wires under their control in order to investigate this novel phenomenon. Edward Bright was largely responsible for the establishment of telegraphic communication between the West Indian Islands by some 5000 miles of submarine cable. He was a member of the Institution of Civil Engineers and a member of council of the Institution of Electrical Engineers.

THE Royal College of Surgeons has awarded the triennial prize, with which is given the John Hunter medal, to Dr. W. Blair Bell, of Liverpool, for his dissertation on the anatomy and physiology of the pituitary body. The subject of the prize for the next period is "The Human and Comparative Anatomy and Physiology of the Cerebellum." The Jacksonian prize for the year 1912 has been awarded to Mr. F. W. Goyder, of Bradford, Yorks, for his dissertation on the embryology and treatment of cleft palate. The subject of the prize for the year 1914 is "The Pathology, Diagnosis, and Treatment of Trigeminal Neuralgia."

A JOINT session of the Aristotelian Society, the British Psychological Society, and the Mind Association will be held in London on June 7 and 8. In the afternoon of June 7 there will be a symposium, "Are Intensity Differences of Sensation Quantitative?" to which Messrs. C. S. Myers, Dawes Hicks, H. J. Watt, and Wm. Brown will contribute. In the evening there will be a discussion of a paper by Dr. Arthur Robinson on memory. The subject of a symposium on June 8 will be, "Can There be Anything Obscure or Implicit in a Mental State?" and Messrs. Henry Barker, G. F. Stout, and R. F. A. Hoernle will take part.

WHATEVER may be the subsequent effect, if any, of the removal of the Royal Geographical Society from its old centrally situated premises in Savile Row to the "West End," there can be no question as to the enhanced convenience and amenities afforded by the new home at Kensington Gore, which the Society

opened on Monday last, after an enforced sojourn in temporary quarters at Cromwell Gardens since the beginning of the year. The house, formerly known as Lowther Lodge, has proved excellently adaptable to its new purpose. The ground floor provides a museum and lounge, in addition to two map-rooms and a council-room—a change indeed from the conditions at Savile Row. The accommodation on the first floor serves for the library, for various rooms for the convenience of fellows, and for offices; on the second floor is the surveying school, with students' and draughtsmen's rooms, while the roof provides space for an observatory for the purposes of the school. The intention is to dispose of a considerable portion of the land attached to the house, but sufficient will be retained to form a pleasant open space on the south side of the building.

Three evening lectures (the Chadwick Public Lectures, 1913) on the evolution of epidemics are being given by Dr. J. T. C. Nash, at the Royal Society of Medicine, 1 Wimpole Street, W. In his first lecture Dr. Nash pointed out that, although measles is so constantly with us, and smallpox is generally so distinctive, and is yet common enough in various parts of the world, no causal germ has yet been definitely recognised for either disease. Certain other specific diseases have been found to be due to the life-processes within the blood and tissues of higher forms of life than mere bacteria. Malaria is an example of such. In pre-vaccination days smallpox in Great Britain showed a periodic intensity of prevalence every three, four, or five years, but during the latter half of the nineteenth century, since vaccination was made compulsory in 1851, only one widespread epidemic occurred, in 1871–72, when smallpox overran Europe and America; but it must be remembered that vaccination was not the only measure in force, and compulsory notification, disinfection, isolation, "following up" of contacts throughout the incubation of the disease, all assisted in limiting the spread of infection and widening out the inter-epidemic periods. In commenting upon the second Chadwick Lecture, delivered on Monday last, Sir Richard Douglas Powell, who presided, said that Dr. Nash's arguments were of great importance in leading to a salutary speculation on the true character and possible removability of endemic, as well as epidemic diseases. May it not be that the bovine, avian, and human forms of tubercular diseases are distinct only from the fact that for many generations the micro-organisms have been cultivated in the special environments of beasts, birds, and mankind, and that the root-ancestor of all was a fungus dwelling in the earth and ever ready to spread into animal soil? Dr. Nash's lectures should do much to lead students of the etiology of tuberculosis to look back into long-forgotten factors, such as that of soil, which were discussed by Buchanan and other men of medicine in his (Sir Douglas Powell's) early years. The next lecture will be given on Monday next, April 21, when Sir William J. Collins will preside.

In June Dr. F. W. Mott, F.R.S., will give a course of Chadwick Public Lectures at the Royal Society of Arts, under the title of "Nature and Nurture in Mental Development." Among the lectures in contemplation for the provincial cities are those on the public milk supply—some criticisms and suggestions from the public health point of view, by Prof. Henry R. Kenwood, at Cardiff; on water supply, with exhaustive consideration of sources, collecting works, conveyance, and distribution, by Mr. E. P. Hill, at Birmingham; and on infant welfare, by Prof. Karl Pearson, F.R.S., at the School of Economics, May 16, 23, and 30. Glasgow, Bristol, and other cities of the kingdom will also be provided with Chadwick Public Lectures during the year. All the lectures will be free and open to the public, but will be of a character to attract post-graduate and advanced students of engineering, medicine, and other cognate sciences. The secretary to the trust, to whom all communications should be addressed, is Mrs. Aubrey Richardson, 8 Dartmouth Street, Westminster.

The Eugenics Record Office, which was established at Cold Spring Harbor, Long Island, in October, 1910, by Mrs. E. H. Harriman, with the additional assistance of Mr. John D. Rockefeller and others, has recently entered upon a new stage of its development. A board of scientific directors has been organised, comprising Dr. Alexander Graham Bell, chairman; Dr. William H. Welch, professor of pathology, Johns Hopkins Hospital, vice-chairman; Prof. Irving Fisher, Yale University; Prof. Lewellys Barker, of Johns Hopkins Hospital; Prof. E. E. Southard, of Harvard University, and director of the Psychopathic Hospital, Boston; and Dr. C. B. Davenport, secretary of the board and resident director. The board met at Cold Spring Harbor on March 21, and organised its work. The aim of the Eugenics Record Office was defined to be as follows:—(1) To promote researches in eugenics that shall be of utility to the human race. This part of the programme includes the study of America's most effective blood lines and the methods of securing the preponderance and relative increase of the best strains; the study of the origin of and the best methods of restricting the strains that produce the defective and delinquent classes of the community; the study of the method of inheritance of particular traits; the study of the consequences of the marriages of close kin; the study of miscegenation in the United States; the study, both in that country and abroad, of the family histories of permanent immigrants. (2) To publish the results of these researches. (3) To provide a fireproof building for the preservation of eugenical records, including genealogical works and town histories. (4) To provide an administrative office and staff to carry out the work.

In the third part of his useful periodical, *Visva-karma*, Mr. Ananda K. Coomaraswamy gives a further selection of examples of Indian sculpture. The present instalment is devoted to specimens from Java, Cambodia, and Ceylon, all of which betray Hindu influence, while two fine examples from Sarnâth, near Benares, and from Nepal are excellent illustrations of the local art. The photographs are now more artistically reproduced than in the first number of the

series, and the collection will be of interest to artists and students of the religions of the East.

We recently deplored the lack of encouragement and support received by the Royal Anthopological Institute of Great Britain and Ireland from the State and the public of this country. When we turn to America the case is very different. From the forty-sixth report of the Peabody Museum of American Archæology and Ethnology, connected with the Harvard University, we learn that steps are being taken to complete the museum buildings according to the original plans prepared fifty-three years ago by Louis Agassiz. The plans provide for the addition of five exhibition halls, each 100 by 60 ft., a stack-room for the library, several workrooms and offices, a photographic room, a lift, and other conveniences. These important extensions are needed to supply accommodation for the vast collections of material which are being collected by parties of explorers at work in all parts of the country, under the guidance of the museum authorities, and the large donations presented to the institution by members of the public.

In *Man* for April Mr. T. C. Hodson discusses the question of seasonal marriages in India. During last February the Kadva Kanbis of Gujarat celebrated, after an interval of some ten years, the weddings of all the marriageable youths and girls in the tribe. A similar custom prevails among a group of the Madras Chettis, and among some Karens in Burma it is only when an official visits their country and orders a wedding to take place that the ceremony is performed. This custom may be an extension of the human pairing season which has been discussed by Prof. Westermarck. At present, among the Kanbis, it seems to be the result of a system of hypergamy —the desire to marry a girl in a grade higher than her own—which results in a scarcity of bridegrooms and increase of the bridegroom price. But it may have originated in some belief connected with astrology, or some tribal custom the cause of which is now obscure.

The Journal of Genetics for February (vol. ii., No. 4) contains three papers, two of which are more of the nature of general reviews and discussions than records of original observation. Dr. A. H. Trow discusses "Forms of Reduplication"—the phenomena more generally known as gametic coupling and repulsion. He points out that if there are factors A, B, C, in which there is coupling between A and B and between A and C, then there will of necessity be secondary coupling between B and C. He works out formulæ for the "secondary reduplication" and compares them with actual cases already recorded. Mr. Clifford Dobell reviews the present knowledge of mutation in bacteria, devoting the greater part of his paper to physiological mutations, *i.e.* inherited changes in the power of producing ferments or pigments. He shows that such mutations have been frequently described, that many of them are apparently spontaneous, but that in some cases at least they are due to change of environment, and that in this case they are not rarely adaptive. Mr. K. Toyama gives a detailed account of the inheritance of egg-characters in the silkworm (*Bombyx mori*). There are a number of definite characters (shape, colour, &c.) in various breeds, and his most important result is that the majority of these characters, even when they depend upon the embryo and not upon the shell, are determined by the constitution of the female parent, and not by that of the embryo. For example, a female of a breed having eggs with the recessive character, mated with a male of a breed having eggs with the dominant character, produces eggs of the recessive character, but the females reared from these eggs, however mated, lay eggs with the dominant character.

"Dominancy in Nature" is the title of the presidential address (of which we have been favoured with a copy) delivered by Mr. J. W. Taylor at the annual meeting of the Yorkshire Naturalists' Union, held on December 14, 1912. The author holds the view that western and central Europe was the birthplace, or dispersal centre, of nearly all groups of animals.

In an account of the manner in which bees collect pollen, published as Bulletin No. 121 of the Entomological Bureau of the U.S. Department of Agriculture, the author, Dr. D. B. Casteel, states that the articles published by Mr. F. W. L. Sladen in 1911, 1912 (one of which appeared in our own columns, February 29, 1912, p. 586), afforded the first true explanation of the function, and that his own observations have confirmed the accuracy of Mr. Sladen's work. "Pollen," he writes, "may be collected by the worker upon its mouth-parts, upon the brushes of its legs, and upon the hairy surface of its body. When the bee collects from small flowers, or when the supply is not abundant, the mouth-parts are chiefly instrumental in obtaining the pollen. The specialised leg-brushes of the worker are used to assemble the pollen, collecting it from the body-parts, to which it first adheres, and transporting it to the pollen-baskets, or corbiculæ, of the hind-legs. In this manipulation the fore-legs gather pollen from the mouth-parts and head; the middle-legs from the fore-legs and from the thorax; the hind-legs from the middle-legs and from the abdomen. . . . A little pollen is loaded directly from the middle-legs into the baskets when these legs are used to put down the pollen-masses."

In the March number of *The American Naturalist* Prof. Kellogg, of Stanford University, reviews the results of his laborious investigations into the geographical and "host" distribution of the external parasitic insects commonly known as bird-lice (Mallophaga). Despite their popular name, nearly 100 out of the 1500 known species are parasitic on mammals, although none of those infesting mammals visits birds, or *vice versâ*. Indeed, with a few exceptions in a couple of genera, the mammal-infesting species belong to families distinct from those parasitic on birds; the members of the former group, in adaptation to a life spent among fur instead of feathers, having discarded one of the two terminal claws of the limbs. After referring to the fact that the various species of these parasites are to a great extent restricted to

particular species or groups of kindred species of hosts, the author directs attention to the remarkable fact that certain kinds of these lice are to be found on hosts completely sundered from one another by geographical barriers. The European and the American avocets have, for example, two species in common, while the Old World and New World bitterns have one. To explain this the author suggests that the parasitic species has been handed down practically unchanged to its present hosts from their common ancestor, and consequently that the species of bird-lice are much older than the birds they infest.

In a report on wheat experiments in the United Provinces (Bull. 32, 1912, Agricultural Research Institute, Pusa), Mr. H. Martin Leake and Ram Prasad direct attention to the high yields often obtained. Whereas the average outturn of grain per acre for the Fatehpur area is given as 1250 lb. for irrigated, and 600 lb. for non-irrigated land, yields of 1700 to 2000 lb. were often obtained in these experiments, whilst a yield of 2200 to 2400 lb. may be expected under favourable conditions. These relatively high returns are not attributable to the use of manures or to rich soil, but are probably due to the adoption of hot-weather cultivation. Actual experiments show the value of this practice and indicate it to be cumulative in effect.

An interesting account of experiments on the utilisation of pasteurised milk for Cheddar cheese-making has been published by Messrs. J. L. Sammis and A. T. Bruhn (Research Bulletin 27, Univ. Wisconsin Agric. Exp. Stat.). In practice, the processes of cheese-making have been subject to daily variation on account of qualitative and quantitative differences in the initial bacterial flora of the milk, and the resulting product has varied accordingly. The above investigators have now devised a method by means of which these initial differences are eliminated. The milk is first pasteurised at 160° to 165° F., whereby about 99 per cent. of the bacteria are killed; the reaction of the milk is then corrected, by the addition of hydrochloric acid, to 0·25 per cent. acidity (stated as lactic acid); a pure culture of lactic acid bacteria is added, and all subsequent processes can be carried out according to a time schedule. It is also claimed that the quality of the product is more uniform than that of cheese produced by the ordinary method; the cheese may be safely stored at high temperatures; the losses of fat are lower, and the average yield is higher than under ordinary conditions. In addition to providing a means of destroying pathogenic organisms contained in the milk, the method may prove of value in connection with research on the processes of cheese-ripening.

An article by Mr. N. Mori, on the formation of "tree-frost" in northern Japan, appears in the February issue of the Journal of the Meteorological Society of Japan. The author distinguishes this from hoar-frost, which is formed at or about freezing-point, observing that "tree-frost"—which appears on various objects, but principally upon the branches of trees—follows on early morning mist and a temperature of from 10° to 30° below freezing-point. In appearance "tree-frost" is quite different from hoar-frost, resembling white blooms. The author regards the phenomenon as due to the direct freezing on to the tree-branches of the minute watery particles of mist formed at a temperature below freezing-point. Mr. R. Hirano, of the Tadotsu Meteorological Station, has an article on *shigure*, or drizzling rain, in which he seeks to draw scientific deductions from references to the subject in Japanese poetry ranging over a period of more than a thousand years. Among other matters of interest is an account, by Baron Yoshida, of a cloud pillar observed in Kaga province, on the Japan Sea coast, on the afternoon of December 25, 1912. Snow had been falling and covered the ground to a depth of 4 or 5 in., but had ceased, and the sky was clear, with the exception of some cumulo-stratus clouds. Among them a curious ash-white cloud made its appearance, and from this suddenly was seen to rise a whirling column, which moved off in a northerly direction. A smaller column was formed in its rear and followed it at an equal distance. Both columns vanished in about eight minutes, the smaller being the first to disappear.

In the issue of Nature for July 28, 1910 (vol. lxxxiv., p. 118), attention was directed to the method of treating storage cells seriously reduced in capacity by sulphating, which had been used with great success by Mr. J. O. Hamilton, of the Kansas State College. At a recent meeting of the American Electrochemical Society, Messrs. C. W. Bennett and D. S. Cole, of the electrical engineering department of Cornell University, described the results of applying a similar method to the college battery of fifty-two cells, which, owing to sulphating, had a capacity of only 30 instead of its rated capacity of 60 ampere hours. The acid was removed from the cells and replaced by a 10 per cent. solution of pure sodium sulphate. The battery was then charged for 53 hours, and the plates removed, washed, and replaced in their proper acid. The capacity was found to be increased to 58 ampere hours, and the total cost of the treatment worked out at 10*d.* per cell. An abstract of Messrs. Bennett and Cole's communication will be found in *The Electrician* for March 28.

The Journal of the Franklin Institute for March contains an article by Mr. H. T. Herr, of the Westinghouse Machine Company, on recent developments in steam turbines. This article gives an excellent account, with drawings, of the present turbine practice of the Westinghouse Company. The author states that scarcely any turbine of anybody's make ever gave trouble due to blades breaking or coming out because of centrifugal force. Breakages are accounted for by vibrations, and until lashing of the longer blades was resorted to, breaking was caused by individual vibration. The lashing, or shrouding, must not be continuous, as provision for unequal expansion due to heating must be taken account of; hence, all lashed blades must be arranged in segments not exceeding 2 ft. for large diameters. These segments may vibrate as a whole, but the lashing has the effect of increasing the frequency and

diminishing the amplitude of the vibrations. Lashing or shrouding is therefore a palliative against vibration, and not a cure. It is the practice of the Westinghouse firm to lash all reaction blades above 1 in. in length, and very long blades may have three or four rows of lashing wire.

As is well known, air in excess of that which is required to ensure complete combustion of the fuel under a boiler carries away heat wastefully to the chimney, and the boiler and its flues are less efficient in absorbing the heat which has been produced. Engineers, therefore, test flue gases for carbonic acid, as an unduly small proportion of this corresponds to unnecessary excess of air. This is generally done by ascertaining the reduction in volume of the flue gas after treatment with a solution of caustic soda. These wet chemical methods, of course, work well enough, but the lower-grade type of engineer does not take kindly to them. The Underfeed Stoker Co., Ltd., of Coventry House, South Place, E.C., however, has put on the market, at a cost of five guineas, an extremely neat pocket apparatus, called the CO_2 thermoscope, in which no liquids are used. A measured charge of the gas is passed through a charge of powdered caustic soda contained in a copper cap looking like a detonator, but sealed at both ends. The ends are first pricked and then the cartridge is placed within the hollow bulb of a mercurial thermometer contained within the instrument. The zero of a sliding scale is then set to the mercury index and the piston of the instrument is pushed home so as to drive the gas through the cartridge of caustic soda. This heats up the cartridge, and the thermometer, acting as a calorimeter, shows directly on the scale the proportion of CO_2 present. Provision is made for eliminating the effect of temperature on the volume of the gas taken. As in the wet process, SO_2 counts as CO_2, but in this case in a higher degree in consequence of the greater heat of combination.

OUR ASTRONOMICAL COLUMN.

THE QUESTION OF RADIUM IN THE CHROMOSPHERE.—Bulletin No. 27 of the Kodaikanal Observatory contains an important statement by Mr. Evershed regarding the recent communications concerning the presence of radium and the elements of the inactive group in the chromosphere. One of the recent communications concerned a comparison made by Mr. Dyson of the lines of radium and the emanation with the bright lines in the chromospheric spectrum as observed at eclipses; this comparison indicated many apparent coincidences of wave-length, and he suggested that these elements may be revealed by their emission lines, although not by their absorption lines, as is the case of helium. In the first part of the paper Evershed deals with the comparison of the chromospheric lines with those of radium and the emanation. He employs for the chromosphere the spectra he obtained during the eclipse of 1900 for the ultra-violet region of the spectrum and the spectra (glass positives from the original) secured by Dr. Mitchell at the eclipse of 1905; these latter are, as he states, "the finest that have ever been obtained in the less refrangible region." In the second portion he devotes his inquiry to the question of the presence of neon or argon in the chromosphere, using the wave-lengths of the chromospheric lines as obtained by himself, Lockyer, and Dyson, and discusses the spectra thoroughly.

The result of his inquiry, to use his own words, is to show "that with the best eclipse material now available and the most recent measurements of the lines of the elements in question, the evidence is of a distinctly negative character as regards radium and the emanation, as well as neon and argon, and the probability is that not one of these elements can be recognised in the sun by a study of the emission spectrum of the chromosphere any more than by a comparison with the solar absorption spectrum." He further states that he has also examined the spectra of krypton and zenon, and also finds no evidence for their presence in the chromosphere.

DEDICATION OF THE NEW ALLEGHENY OBSERVATORY.—The corner-stone of the new buildings for this observatory was laid by Mr. John A. Brashear on October 20, 1900. The director at that time was Prof. F. L. O. Wadsworth. The work of building and transference has been completed, and the observatory dedicated with religious solemnity and handed over to the trustees of the University of Pittsburgh. We have lately received (Misc. Sci. Papers, Alleg. Obs., N.S., vol. ii., No. 2) an account of the dedicatory exercises and presentation which took place on August 18 of last year, and were referred to in NATURE of September 19, 1912 (vol. xc., p. 89). It is a pity that such stimulating scenes do not mark the history of astronomy in England. The various speeches are given in full, and in an appendix is given the speech made when the corner-stone was laid. Happily, Mr. John Brashear, to whose personal endeavours the new observatory owes so much, has lived to see crowned the works he then put in progress.

GENERAL INDEX TO THE MEMOIRS OF THE SOCIETY OF ITALIAN SPECTROSCOPISTS.—The fortieth anniversary of the above society and the completion of forty volumes (1872–1911) of the memoirs have been celebrated in a manner "modesta ed utile" by the preparation and publication of an *Indice Generale delle Memorie*. The index is made "per Autori e per Materia." The latter part is not an alphabetical list of titles juggled on the change-ringing system adopted in some catalogues, but consists of a number of natural divisions of the subject forming heads of lists of papers arranged chronologically under author's names. Prof. A. Ricco is responsible for the grouping. Other members of the staff of the Astrophysical Observatory of Catania have assisted.

NATIONAL ASPECTS OF EDUCATION.

SEVERAL notable utterances relating to our national scheme of education have recently been made by Lord Haldane and other members of the Government. Apparently the intention of the Government is to introduce a measure which will organise our educational institutions and forces on a national basis, and in the spirit worthy of a great modern State. Among the developments adumbrated are the raising of the leaving age of compulsory attendance at primary schools, the abolition of the "half-time" system, compulsory attendance at continuation schools, the correlation of primary and secondary schools, improvement of the status of teachers, increased number of provincial universities and of facilities for entering them.

The development of national education along such lines as these signifies a substantial increase of expenditure; and as the contributions from rates for educational purposes have reached breaking-point in

most districts, the main part of the increased burden will have to be borne by the State. Since 1870, the proportion of the cost of education borne by the rates, in comparison with that contributed from national sources, has grown very considerably; and a readjustment of the load is imperative. Lord Crewe referred to this disproportion in the course of a speech at a dinner given to Lord Haldane by the Eighty Club on April 4, and he remarked:—"We cannot coordinate our system without incurring a heavy cost, and the question the Government will have to put is: Is the country prepared, when it has seen our proposals, to say that the benefits which those proposals offer justify a further expenditure, which cannot be small, upon national education." Lord Haldane has also acknowledged (in his speech at Manchester in January last) that "One thing is quite certain—what is about to be done for the coming generation must not be done at the expense of the ratepayer." In various speeches since the opening of the campaign at Manchester he has referred to the national responsibility for the development of our educational resources, and the national advantages which will accrue from it. Speaking at a joint meeting of secondary-school and technical teachers at the University of London on March 29, he said:—"The expenditure on education is productive expenditure, which we are justified in making a sacrifice to incur with the certainty that we shall get it back with compound interest."

It is refreshing to find our Ministers accepting the principle that increased provision for education must come from the State, and that the nation will benefit by the additional expenditure. Not many years ago Lord Haldane, in an introduction to Sir Norman Lockyer's collection of addresses on "Education and National Progress" (1906), suggested that the private donor should be encouraged, but that the motto of the Chancellor of the Exchequer as regards expenditure upon matters connected with higher education and research should be *Festina lente*. "I do not mean," he wrote, "that the Government ought not to spend public money generously upon the universities. I mean that it should not be spent unless and until a case for the necessity of such expenditure has been clearly made out."

We may be permitted to conclude from his recent utterances that Lord Haldane is now of the opinion that a case has been made out for increased national provision for our educational forces. He knows as well as anyone that the great advances being made in education in other countries constitute a formidable menace to ourselves, and that the State can wait no longer for like developments if it desires to maintain a leading position among progressive peoples. What Lord Haldane and other members of the Government have been saying recently as to the responsibility of the State for educational progress has not only been said in New South Wales, but put into practice by the Labour Government now in power. The official pronouncement of the New South Wales Government upon education may appropriately be quoted here; it reads:—

"The present Government, recognising that economic reforms are of little value without increased educational facilities, attaches supreme importance to educational reforms. 'A man might have access to land, facilities of travel, industrial energy, credit, economic security, and justice, and yet true equality of opportunity might be lacking. The society where all these liberties have been won might be sunk in the stagnation of conservatism, and might even breed new forms of inequality and tyranny.' Every improvement in economic conditions should be accompanied by an effort to raise the standard of intelligence, and this will only be achieved by the State recognising its ever-increasing responsibility to provide increased educational facilities."

The article by Prof. H. S. Carslaw in NATURE of April 3 shows how the policy outlined in this manifesto has now been carried out in New South Wales; and the reforms there instituted are much the same as those urgently needed in the mother-country. To attempt to describe in detail the many directions in which our educational system requires organisation, improvement, and extension would take the present article beyond reasonable limits, but reference may be made to a few matters mentioned in recent speeches.

Much has been said of the work of the elementary school in relation to after-life. The great difficulty here is to know what the life after school is to be. More than 40 per cent. of the boys leaving London schools go into irregular employment; not so much, perhaps on account of any want of fitness to learn a trade as because of the ease with which such "blind-alley" occupation can be found, and the relatively higher wages which can be obtained. It is not the province of the elementary school to prepare for any particular occupation, but so far as possible to guide the child to appreciate what is best in life, to train his hand and eye to work together, and to make him trustworthy, alert, and adaptable in whatever calling he may be placed. There should certainly be more manual work in schools, but its aims and methods should be educational and not technical. To attempt specialisation in an ordinary school, from which the boys leave to enter fifty or more different occupations, would lead to hopeless confusion. Manual dexterity can be trained in schools at an age when it is most easily acquired without attempting to teach the processes of particular occupations. The effect of giving more time and attention to work of this practical nature would perhaps be to increase the dignity of manual labour, and to lead ambition into industrial rather than clerical directions.

In rural districts the difficulty in making the elementary-school curriculum less bookish is the teacher, who frequently has no special aptitude for the work, and has rarely received a special training. So long as there is no inducement for teachers to qualify themselves for work in rural schools, no improvement can be anticipated. At present the rate of pay is lower than in town schools and the opportunities of advancement are fewer; so that young teachers naturally object to become earmarked for country schools. Exceptional qualifications are demanded without any inducement being offered to teachers to obtain them. The teacher in a rural school is expected to have the spirit of a naturalist, the manual dexterity of an artisan, the experience of a horticulturist, and the culture of a university graduate, and for these admirable qualities he will receive the pay of a second-rate clerk. It is unreasonable to expect that many men and women possessing such attributes will have no higher ambition than that of teaching in country schools.

One of the reforms contemplated by the Government is the raising of the age below which attendance at school is compulsory, and the abolition of the "half-time" system. At present, a child can leave school immediately it reaches the age of fourteen years, irrespective of the standard in which it may be at that time. About 10 per cent. of the children in public elementary schools leave each year, and they are usually in Standard VI., so they have had the full opportunities of whatever education the schools are giving. Partial exemption from school in order to go to work during certain hours of the day can be obtained at the age of twelve by obtaining an attendance certificate, or at eleven in agricultural districts

if the standard of exemption fixed by the local education authority has been passed. This is the "half-time" system, and in the year 1910–11 the number of children who took advantage of it was 71,475. 80 per cent. of whom belong to the districts of Lancashire and Yorkshire engaged in textile industries. The total number of pupils in attendance at public elementary schools of England in the year 1910–11 was nearly 5,000,000, so that the "half-timers" form only about 1½ per cent. of the children under instruction, and since the year 1907–8 the number has been continually decreasing.

Little can be said in favour of the "half-time" system from the point of view of the child's physical, mental, and moral development, all of which are sacrificed by it to the interests of some parents and employers. The facts described in the work on "Continuation Schools in England and Elsewhere," edited by Dr. M. E. Sadler, provide an unanswerable indictment of the system by which child-labour is exploited because it is cheap and the educational discipline of school is minimised at a period when it is most needed.

Several attempts have been made to abolish the half-time system, the most recent being the Education (School Attendance) Bill, which was introduced in the House of Commons last year, and was afterwards sacrificed. The Bill provided that no child under the age of thirteen should be allowed to leave a public elementary school, and that a child should only be allowed to leave school before the age of fourteen for the purpose of entering into some beneficial employment. It was left to the local education authority to decide whether the conditions of the proposed employment were suitable to the child, and whether it was likely to lead to permanent employment and to afford useful training.

It may be possible to find arguments in favour of permitting a child to leave school relatively early in order to enter employment which will make him a skilled workman, but no amount of special pleading will prove that a child of twelve is benefited by working six hours in a mill each day and attending school for two and a half hours as well. When the school curriculum is of a more practical character than it is at present—and many education authorities are making it so—it will not be reasonable to urge, as Sir William Anson did last year, that the mechanical drudgery of the mill-room is more valuable for after-life than instruction in educationally-graded courses of manual work and housecraft.

The great majority of children who leave the elementary schools receive no further school training. The following table, based upon the statistics prepared for the Board of Education by the Continuation Schools Committee which was appointed in 1907, gives some indication of the numbers of adolescents receiving no regular education:—

Boys and Girls (England and Wales), 1906–7.

Age	Population	Not at school (either day or evening) No.	Per cent.
12	687,300	14,424*	2·10
13	690,300	155,871	22·58
14	691,000	442,950	64·10
15	682,100	523,383	76·73
16	649,200	532,016	81·95
17	664,900	557,632	86·87

It is a common complaint that what is learnt in school is soon forgotten in after-life. This is true of most subjects and of most children; and the loss of the knowledge is usually the result of disuse. The above table shows that a very small proportion of children from elementary schools continue their education by attendance at continuation schools, the result being that in most cases they are unable after a couple of years to perform the simplest arithmetical calculation or show evidence of having received instruction in any ordinary subjects other than reading and writing. This is a bad beginning for after-life, and the nation will benefit by any measure which will bring pressure to bear upon parents and employers to ensure attendance at continuation schools. In Germany, twenty-seven States have adopted the compulsory continuation-school system, which imposes the statutory obligation on all employers of labour to give their employees under eighteen years of age such leave of absence from work for the purpose of attending the schools as the local authorities may prescribe. It is time that similar measures were adopted in our own country. The years of youth and adolescence, when supervision, discipline, and guidance are particularly needed, are at present left unguarded by the State. It is true that we have in the three-quarters of a million students who attend evening and similar schools an army of voluntary students of which any nation may be proud, but nearly one-fifth of these students fail to complete the small minimum of attendances (from thirty to sixty hours) required to enable grants to be claimed towards their instruction, and most of the remainder only receive very elementary instruction, comparable perhaps with the work of continuation and trade schools in Germany, but forming no satisfactory substitute for the highly developed system of secondary and technical education in that country.

We do not suggest that the education system of Germany is adapted to the needs of our own country and people, but we do believe that until a national system of our educational institutions has been formulated comparable with that of our chief competitor, it will not be possible to inspire confidence in the expenditure of large sums of public money on education. We go to Germany for our illustrations because there the result of organisation by the State has been to raise education out of the slough of commercialism and make the people appreciate its advantages to the nation and the individual. If comparison with Germany is permissible in the case of armaments, it is much more so in connection with education, in which we ask, not for two schools to one, but an approach to equality.

In true secondary schools, high-grade technical institutions, and advanced university students lie our weaknesses as compared with Germany. There are nearly 1000 recognised by the Board of Education as efficient secondary schools in England and Wales, and they are attended by about 170,000 boys and girls, three-fifths of whom are from public elementary schools. Three-quarters of these pupils are, however, under fifteen years of age, and if pupils under twelve years of age be left out of consideration the average length of the secondary-school life is less than three years. Germany has in its secondary schools more than twice as many pupils as are in our State-aided secondary schools, and all taking courses lasting six or nine years, leading to definite goals and linked up closely to the public life. The leaving certificate obtained after passing through a nine-years' course qualifies for entrance into any German university, and to any of the learned professions. We have no such general certificate for the pupils of our secondary schools, and the standard of the certificate could not be passed successfully by the majority of the students in our universities, while to apply it to the product of our schools at present would be impossible.

With few exceptions, our technical institutions also

will not bear comparison with the technical high schools of Germany, either as regards number of students or nature of the instruction. The total number of day technical students in English polytechnics, technical schools, and colleges, and in universities and university colleges recognised as technical institutions by the Board of Education, is about 4000; and less than one-fifth have passed a university matriculation examination or its equivalent upon entrance. Less than 2000 day students are taking full courses of instruction in technical institutions in England and Wales, though this number includes students of technology in several provincial universities or university colleges. The technical high schools of Germany and Zurich have together more than six times as many day students taking full four-year courses, after having completed a full secondary-school course and obtained the leaving certificate. If the same standard were required for entrance to our technical institutions, most of them would cease to exist.

Our position as regards university students is equally unsatisfactory when compared with that of Germany. In the whole of the universities of England, including Oxford and Cambridge, there are about 17,000 full-time students, whereas Germany has four times as many. The University of Berlin alone has 10,000 matriculated students; Leipzig 5000; Bonn, Breslau, and Halle more than 3000 each, and six other universities more than 2000. We have a long journey to make before we can approach the position occupied by Germany as regards secondary, technical, or university education, and it is the State which must take the lead if we are to make up our leeway. The first requirement is to organise our educational institutions into a truly national system; that is to say, upon a system which has the well-being of the nation as its main object, and in which facilities are offered to every individual to secure the highest instruction if he is qualified to take advantage of it.

The raising of the leaving age of elementary schools, the abolition of the "half-time" system, the establishment of compulsory continuation schools, and the coordination of elementary and secondary schools are reforms for which England ought no longer to wait, but of greater importance from the point of view of national progress is the development of higher technological instruction and research in our technical colleges and universities. The importance of this was emphasised by Mr. H. G. Wells in three articles contributed to *The Daily Mail* on April 7, 8, and 9. Mr. Wells's theme was the nature of our naval and military armaments and the national expenditure upon these preparations for war; and he urged that too much confidence is placed in obsolescent instruments of destruction and far too little encouragement given to organised technical research, military and naval experiment, and other means by which a secure position can be obtained by the aid of science. "I will suggest," he said, "that we have the courage to restrain and even to curtail our monstrous outlay upon war material, and that we begin to spend lavishly upon military and naval education and training, upon laboratories and experiment stations, upon chemical and physical research, and all that makes for knowledge and leading, and that we increase our expenditure upon these things as fast as we can up to ten or twelve millions a year." The arts of peace, no less than those of war, require the production of as many highly educated, inventive, investigating men as the nation can obtain from all classes of the community. The future of every modern State depends upon the work of its men of science and engineers. Let us hope that this will not be forgotten when the Government gives attention to the organisation of education, and that consideration will be given not only to the acquisition of knowledge by students of various grades, but also to its increase.

R. A. GREGORY.

VARIATIONS IN ATMOSPHERIC CIRCULATION IN TEMPERATE LATITUDES.

DR. A. DEFANT contributes a long paper to the *Sitzungsberichte der K. Akad. der Wiss. in Wien*, March, 1912, in which he discusses the variations in the meteorological elements in temperate latitudes in both hemispheres. In an introductory section he outlines the theoretical conclusions on which he bases his method of investigation. Briefly stated, they are as follows. If a region is a region of rising pressure, a "Steig-gebiet" in the nomenclature of Ekholm, the mean temperature of the atmosphere is below normal, and *vice-versa* if it is a region of falling pressure; but the precipitation is a maximum if the temperature of the atmosphere is above the normal over the region, and a minimum if the temperature is below the normal. Consequently oscillations in the precipitation correspond with oscillations in the variation of pressure, and if the first are periodic, the second will have the same periods.

The argument is ingenious, and would be unquestionably valid if the correlations were complete, but the question naturally suggests itself: "Why not investigate directly the records of pressure, which is less subject to local influences than is the amount of rainfall?" The paper appears to contain no adequate reason against adopting the direct method, but as rainfall is a more important climatic factor than pressure, the results of the investigation have an interest of their own, apart from the theoretical development.

The author has taken the daily weather reports for South America and Australia for the year 1904, added together the published values of rainfall for each day for all stations, and taken the total so obtained to represent the daily rainfall of the region considered. The totals are then written down in series, and the number of maxima during the year is counted and divided into the number of days. In this way an approximate period is obtained. The variation of this period is then eliminated, and the process repeated to give the next period. The method is clearly a rough one, and some discussion of the significance of the periods obtained appears to be necessary. Nevertheless, the results are interesting, and suggest that the application of Schuster's method of analysis to the search for comparatively short periods would repay the labour involved. Defant obtains periods of about seven, twelve, sixteen, and thirty-one days for the southern hemisphere, and by using the values for 1909 finds corresponding periods of about six, thirteen, and twenty-five days in Europe. It may be noted that Turner found evidence of a period of twenty-five days in his analysis of the Greenwich records.

Using some results of Exner's on the effect of the different thermal conditions over land and water, the author finds that a continent is the source of a series of pressure waves which travel from west to east with a velocity independent of the wave-length, and he connects this series of pressure waves with the variation of rainfall. The most important waves are those of which the lengths in degrees of longitude are 360°, 180°, 120°, &c., while next in importance are those of which the length is half the width of a continent or ocean. Their velocity is about 11° of longitude per day in the southern hemisphere, 14·5° per day in the northern. It is clear that if the results of the author's investigations are valid, they will be of great importance in long-distance forecasting.

E. GOLD.

GYROSTATS AND GYROSTATIC ACTION.[1]

I NOW suspend the gyrostat from the horizontal beam by means of this chain terminating in a hook (Fig. 8), which engages, as you see, in a central recess of the rim attachment. The chain, you observe, carries a ball-bearing race. I place the gyrostat with its axis horizontal and leave it to itself. The centre of gravity of the gyrostat lies vertically below the hook, and under those conditions there is no couple tending to tilt the instrument. I transfer the hook to one of the side recesses, set the gyrostat so that its axis is horizontal, and leave it to itself, when instead of falling down it turns its axis in a plane which is nearly horizontal. If I delay the precessional motion the gyrostat descends, if I accelerate the precession the gyrostat ascends. I transfer the hook to the opposite side recess, place the gyrostat so that its axis is horizontal, and again let go. The gyrostat precesses as before, but in the opposite direction. Again I hurry the precession, and again the gyrostat rises; again I delay the motion, and the gyrostat descends.

FIG. 8.—Motor-gyrostat precessing on chain support.

In these experiments, when the hook engages in either of the side recesses there is a couple due to gravity tending to produce angular momentum in a vertical plane. The axis of spin-momentum turns towards an instantaneous position of the couple-axis at right angles to it, at angular speed ω say. If μ be the spin-momentum, and the top has been properly started, angular momentum *about the couple-axis* is being produced at rate $\mu\omega$ by this turning, and this is equal to the moment of the couple. The precessional motion remains at the value required to give just the rate of production of angular momentum corresponding to the couple. This is the point generally missed in popular explanations of gyrostatic action.

It is important to notice, however, that, as these experiments are usually carried out, the precession, though apparently steady to the eye, is not, strictly speaking, perfectly steady. There is a very slight alternate rise and fall of the axis. To get quite steady motion the top must not be simply spun and then left to itself; it must be started with the right amount of precession.

I now place the gyrostat within this wooden tray (Fig. 9). The pivots carried by the rim of the gyrostat engage on bearings provided in the tray, and these are on a level with the centre of gravity of the whole. I hold the tray so that its plane is horizontal, and carry it round in a horizontal circle. Nothing happens. Still holding the tray so that its plane is horizontal, I carry it round in a horizontal circle in the reverse direction. The gyrostat immediately turns a somersault, and is thereafter stable. If I reverse the direction of rotation of the tray again the gyrostat turns a somersault, and remains again quiescent.

The gyrostat is stable, with its axis vertical, so long as the direction of spin coincides with that in which the tray is being turned. If this latter direction is reversed the gyrostat turns a somersault so as to render the two directions coincident. It appears as if the arrangement had a will of its own, and refused to be carried round against its direction of spin.

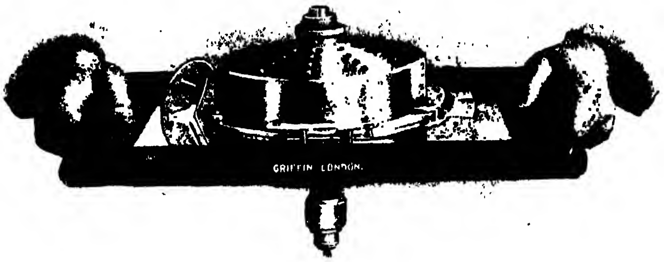

FIG. 9.—Motor-gyrostat mounted to demonstrate the principle of the gyrostatic compass.

The theory of this experiment is very instructive. Both cases are represented by one differential equation, but in one case there is a real period of vibration about the vertical; in the other the period is mathematically unreal, and the gyrostat axis moves further away from the vertical. No better illustration of the two cases of the equation can be found.

The behaviour of the tray-gyrostat is exemplified also in the gyrostatic compass. A heavy and rapidly rotating flywheel is mounted so that its axis is maintained horizontal by means of an elastic support. Under these conditions the equilibrium position of the flywheel under the horizontal component of the turning velocity of the earth (which corresponds to the turning of the tray) is arranged to be that in which the axis of rotation points due north and south. If time permitted, I should be glad to make an experiment with a carefully balanced motor-gyrostat which would not only show the turning of the earth under the gyrostat, but enable the rate of turning to be measured.

[1] Discourse delivered at the Royal Institution on Friday, February 14, by Prof. Andrew Gray, F.R.S. The motor-gyrostats described are the invention of Dr. J. G. Gray and Mr. G. B. Burnside. The gyrostatic tops and combinations used in the latter part of the lecture are due to Dr. Gray. Continued from p. 153.

I would now direct your attention to this motor-gyrostat, which forms the bob of an ordinary compound pendulum (Fig. 10). The tube carrying the gyrostat is attached, by means of a universal joint,

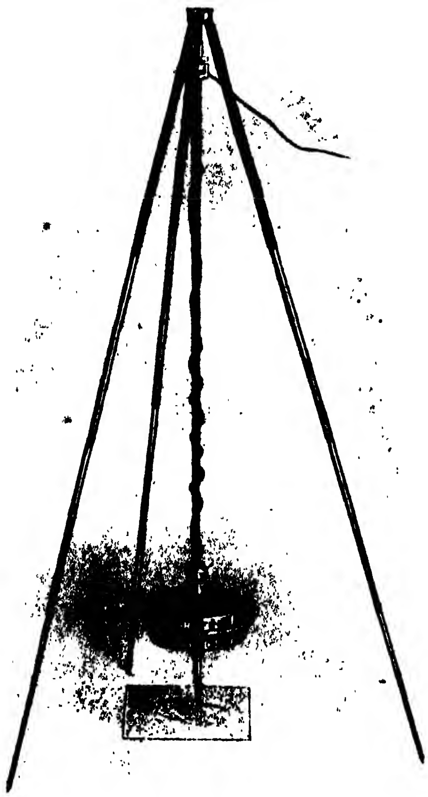

FIG. 10.—Motor-gyrostat fitted up as a gyrostatic pendulum.

to the apex of a triangular stand, made of telescope tubing. The gyrostat is attached to the lower end of its supporting tube by means of a special cap provided with spring contact pieces to allow the current to be led into the motor, and the flywheel is free to rotate about an axis coincident with the rod. Screwed to the lower side of the gyrostat is a pen, which presses lightly on a card placed below.

We have now the pendulum rod in the vertical position. I draw the pendulum to one side and let go, when you see that it vibrates to and fro, and the pen traces out a straight line on the paper. The flywheel has as yet no spin. I start the flywheel revolving, draw the pendulum to one side, and let go, either from rest, or with a certain amount of sidelong motion, when you observe that the pen describes a flower-shaped path (Fig. 11). The path is shown for different amounts of sidelong motion. The peculiar appearance of these curves is due to the rapid falling off of amplitude produced by friction.

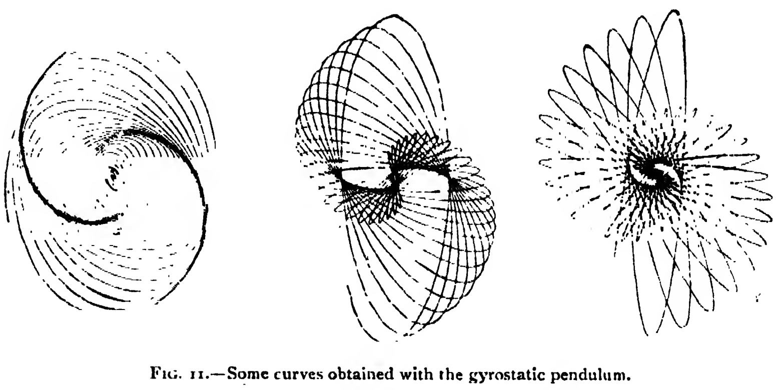

FIG. 11.—Some curves obtained with the gyrostatic pendulum.

When the flywheel is revolving there are, in general, two couples acting on the pendulum, one due to gravity, the other due to gyrostatic action. At an instant at which the axis of the gyrostat is vertical the former couple is zero and the latter one is a maximum, for at that instant the angular velocity with which the axis of the gyrostat is changing direction is greatest. When the pendulum is at one extremity of its swing the former couple is a maximum and the latter one is zero. At that instant the deflection of the bob from the vertical is a maximum, and it is at rest, or is moving sideways, according to the mode of starting, except in so far as the initial conditions have been interfered with by friction. By this relation of the couples the form of the path can be explained.

Another mode of motion is possible which has a very intimate connection with the theory of the vibrations of light-emitting molecules in a magnetic field, as indeed I pointed out here several years ago in a Friday evening discourse (see NATURE, April 13, 1890, and August 24, 1899). The bob can be made to move in a circle about the vertical through the point of support either with or against the direction of rotation of the flywheel. The two periods are different, and the motions correspond to the circularly polarised light of two distinct periods, which molecules, situated in a magnetic field, are found to emit. Thus the gyrostatic pendulum gives a dynamical analogue of the cause of the Zeeman effect.

In 1907 Herr Otto Schlick introduced a method of employing a gyrostat to counteract the rolling of a vessel at sea. The gyrostat is carried on bearings placed athwart the ship. These bearings are in line with the flywheel, and a weight is attached to the frame of the gyrostat in a position in line with the axis. It will be seen that when the ship is on even keel the gyrostat rests with its axis vertical, and with the weight vertically below the centre of gravity of the flywheel. Heeling of the ship in one direction causes the gyrostat to precess in one direction on the bearings on which it is mounted; heeling in the other direction causes precession in the opposite direction, and couples resisting the rolling motion are brought to bear on the ship. The device may be employed in two ways. In the first place, if the bearings on which the frame of the gyrostat is carried within the ship are smooth, the effect of the gyrostat is to resist the rolling force of the waves, and to bring about a lengthening of the free period of the ship, according to a mathematical theory which, when put in the proper way, is really very simple. Excessive rolling of a ship is due to the cumulative action of the waves, and such cumulative action is only possible where the period of the ship and that of the waves are of about the same order. A large ship has a very long period, and synchronism of the ship and the waves is impossible. The effect of introducing a gyro-

static control, operated in the manner just described, is to endow the small ship with the period of a very large one.

In the second mode of operating the gyrostat, friction is introduced at the bearings on which the frame of the gyrostat is mounted. With this addition the ship is forcibly prevented from excessive rolling. In the trials of the device it was found that with the control in operation the angle of roll of the ship did not exceed 1° in a cross-sea which produced a total swing of 35° when the control was out of action. It is interesting to notice that, contrary to the opinions which were expressed when the device was first suggested, the preventing of the rolling of a ship does not result in the waves breaking over her; a ship controlled by a gyrostat is, I believe, a dry one.

FIG 12.—Motor-gyrostat fitted up to demonstrate Schlick's method of steadying a ship in a cross sea.

I have here a motor-gyrostat fitted within a skeleton frame representing a ship (Fig. 12). The frame is mounted on two bearings arranged on wooden uprights, and may be made to oscillate on these bearings, so as to imitate the rolling of a ship in a cross-sea. The frame of the gyrostat is mounted on two bearings placed athwart the frame, and a weight is attached to the outside of the case in a position in line with the axis of the flywheel. The centre of gravity of the gyrostat is in line with the bearings. A clip-device is provided which allows the gyrostat to be clamped to the skeleton frame, and provision is made whereby a graded amount of friction may be applied at one of the bearings.

I now set the skeleton frame vibrating with the flywheel at rest. You observe the period. I start the motor-gyrostat, and repeat the vibrations, with the gyrostat clipped to the frame. The ship rolls precisely as before. I free the gyrostat from the frame, and again set the ship rolling, when you see that not only is the period vastly increased, but the rolling motion is quickly wiped out.

When the gyrostat is clipped to the frame it produces no effect upon the rolling motion. The couples opposing the rolling motion arise from the precessional motion, and hence the gyrostat must be given freedom to precess. In this connection it is interesting to observe that in 1870 it was proposed by Sir Henry Bessemer to obtain a steady cabin for a cross-channel steamer by placing it on a gyrostat with its axis vertical and supported on fore and aft trunnions. This plan was bound to fail. The dependence of the effect on freedom of the axis to precess in a direction which is not that of rolling was not understood. We now see that the object would have been attained by supporting the cabin on fore-and-aft trunnions and mounting the gyrostat, within the cabin, on trunnions placed athwart the ship.

Here is a monorail top of new design (Fig. 13). The frame on stilts represents the car, and mounted on pivots placed across the frame is a gyrostat. Carried by a rod fixed to the frame of the gyrostat, and in line with the axis of the flywheel, is a weight. When the frame is placed on the table so that the legs and axis of the gyrostat are vertical, with the weight above the flywheel, the arrangement is doubly unstable without rotation; the system of gyrostat and weight is usually mounted on the pivots, and the entire structure is unstable about the line of contact of the feet with the table. When the flywheel is rotating, however, the top balances on the table. The two non-rotational instabilities have been stabilised.

I now place the top on the table with the legs and axis of the flywheel vertical, but with the weight below the gyrostat. You observe that the arrangement is unstable. Here there is only *one* instability without rotation, and the result is instability with or without rotation.

Here is a stilt top similar to the one just shown, but provided with wheels adapted to engage on a stretched wire. You observe the remarkable balancing power of the arrangement.

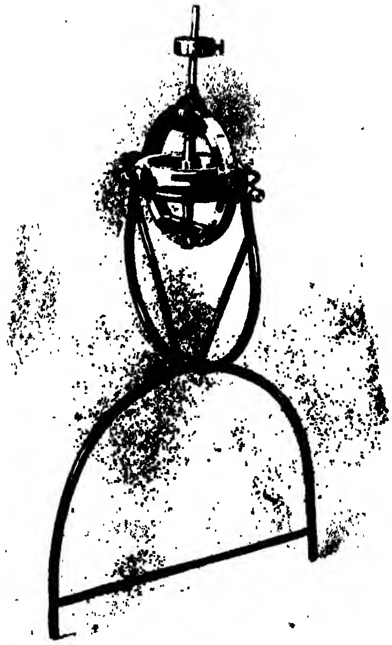

FIG. 13.—New monorail-top.

In this top (Fig. 15) a gyrostat is pivoted within a structure which represents a tight-rope balancer. The structure terminates in wheels adapted to engage on the wire. Attached to the gyrostat are two arms, and carried by these is a light rod weighted at both ends.

My assistant spins the flywheel and places the structure upon the wire with the legs vertical and the pole horizontal. The top, as you observe, balances on the wire. If the top tilts over on the wire towards me the gyrostat precesses in the direction which carries

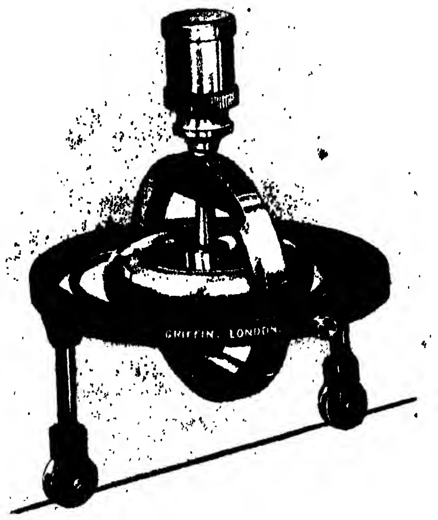

Fig. 14.—Monorail-top.

the pole over towards you, and *vice versâ*. That is, if the balancer begins to fall over to one side it immediately puts over the pole to the other side. The action is exactly that of a tight-rope acrobat.

The rider of a bicycle keeps the machine upright by

Fig. 15.—Pole-balancing top.

operating the handle-bar. If the machine tilts over to the left the rider turns the handle-bar to the left, and the forward momentum of the bicycle and rider, aided by the gyrostatic action of the wheels (a relatively small factor in this case) results in the erection of the machine. Similarly, if the machine tilts to the right the front handle-bar of the machine is turned to the right.

Here I have a small bicycle of the old-fashioned "high" type provided with a gyrostatic rider. When the gyrostat is spinning rapidly you observe that the top is completely stable. The gyrostat operates the front wheel, just as does the rider on the ordinary bicycle.

Again, here is a small safety bicycle provided with a gyrostatic rider (Fig. 16). In this case the gyrostat is mounted above the back wheel, and is connected by arms to the handle-bar of the front wheel. The action is the same as in the other model.

The tops I have shown you are very interesting from the fact that in each case the gyrostat not only detects but sets about correcting any tendency of the top to fall over. It behaves as if it had both a nervous and a muscular system.

I have also here a gyrostat which can be made to progress in space by a reciprocating motion—in fact, a walking gyrostat (Fig. 17). The gyrostat is suspended by two chains from two horizontally stretched wires. The wires are carried by a wooden frame, which is mounted, as you see, on two trunnions carried

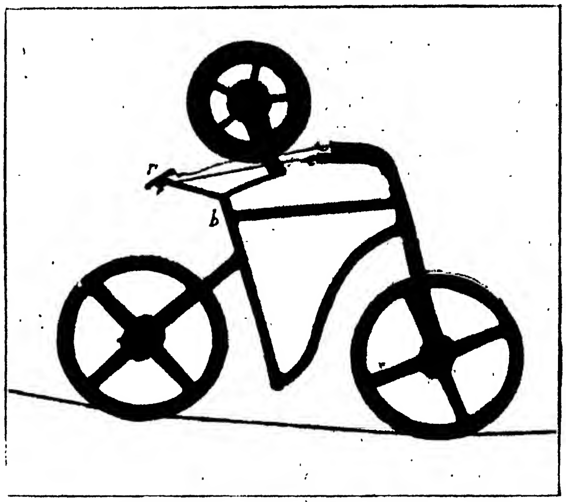

Fig. 16.—Gyrostatic bicycle rider.

by wooden uprights. The chains attached to the arms of the gyrostat terminate in two rings, and these are threaded on the stretched wires.

The gyrostat is spun and replaced on the wires. When the frame is tilted to and fro on the trunnions you notice that the gyrostat walks hand-over-hand along the wires. By the tilting of the frame the weight of the gyrostat is thrown alternately on each of the chains, and in consequence of the precessional motion the gyrostat moves along carrying the chains with it.

At present the spin is great, and therefore the precessional motion is small. The gyrostat proceeds, as you see, with a slow and stately motion. As time goes on the spin falls off, and the rate of walking increases, until finally the gyrostat literally runs along the wires, with considerable loss of dignity. When the gyrostat is enclosed in a box or within an acrobatic figure, the behaviour seems very mysterious.

Here is still another form of acrobatic top, consisting of a large gyrostat, the axis of which is horizontal, and two small ones, with axes vertical, mounted, as you see them, one on each side of the large one, on sleeves threaded on a horizontal bar, as shown in

Fig. 18. My assistant spins the flywheel of the large gyrostat, which is then suspended by means of a string and hook from the upper bar of the frame. At present the centre of gravity of the gyrostat is vertically below the hook, and under these conditions there is no precessional motion. He now spins the two small gyrostats and attaches them to the large one. Each small gyrostat, you will observe, is carried by two sleeves which are threaded on a horizontal bar. The hook is now transferred to one of the side recesses provided in the upper bar of the large gyrostat, and the system is left to itself, when it turns round in azimuth. One of the small gyrostats throws itself up and balances on the bar.

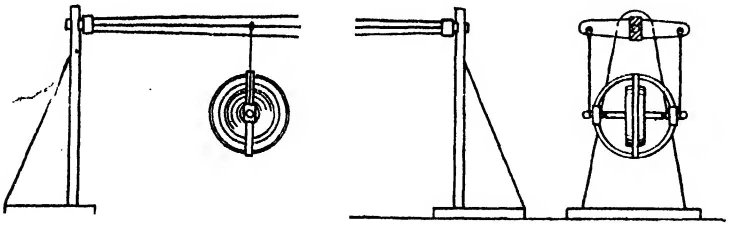

FIG. 17.

The experiment is repeated with the hook engaging in the other side recess, when you observe that the small gyrostat which previously occupied the lower position now rises into the upright one, and the gyrostat which occupied the upright position now occupies the lower one.

This top admits of a large variety of designs. It is easy to imagine a gyrostatic circus rider performing balancing feats on the back of a gyrostatic horse!

I conclude with a gyrostatic model which depends for its action upon an entirely novel and prac-

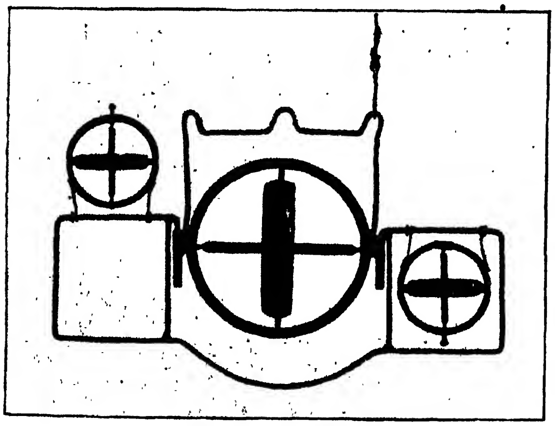

FIG. 18.—Acrobatic top.

tical method of operating a gyrostat or gyrostats. The method has a very large variety of applications, into which I shall not enter at present. It is here shown applied to a motor-car. The car runs on two wheels in tandem; it can be set to run either in a straight path or a path curved in either direction. You observe that the arrangement includes two parts connected by a vertical or nearly vertical hinge. Each is supported on a single wheel. The front part carries a gyrostat with axis horizontal (in this case), the after-part contains the propelling mechanism. A quasi-gravitational field of force is produced by the propeller behind acting through the hinge.

The car can be made to go round in any curve by a weight placed on one side, when it will be seen that it leans over to the inside of the curve.

The balancing power is very great; even when a weight comparable with that of the entire car is mounted on a vertical rod carried by the structure, the device does not fall down. In fact, it is dynamically impossible for the car to overturn.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed to confer the degree of Doctor of Law, *honoris causâ*, upon Admiral Sir Wilmot H. Fawkes, G.C.B., and Mr. J. S. Sargent, R.A.; and the degree of Doctor of Letters, *honoris causâ*, upon his Excellency Adolph H. G. Wagner, professor of political economy in the University of Berlin; Sir Frederic G. Kenyon, K.C.B., director and principal librarian of the British Museum; Sir John Knox Laughton, professor of modern history in the University of London; Sir James A. H. Murray; Prof. C. Bémont, professor of history in the Sorbonne; Mr. Thomas Hardy, O.M.; and Mr. Reginald L. Poole, keeper of the archives of the University of Oxford.

Sir Robert Rede's lecturer for the present year, Earl Curzon of Kedleston, will deliver the lecture in the ensuing Michaelmas term, not, as previously announced, in the present term.

The Linacre lecture, at St. John's College, will be delivered by Dr. Norman Moore, on Tuesday, May 6, at 5 p.m., in the lecture-room of anatomy and physiology, New Museums. The title of the lecture is "The Physician in English History."

MR. W. W. HORNELL, formerly of the Indian Educational Service, and now of the Board of Education, has been appointed Director of Public Instruction in Bengal.

THE council of the South African School of Mines and Technology has made the following appointments to the staff—Dr. G. S. Corstorphine, consulting geologist, of Johannesburg, to be principal of the school and professor of economic geology; Mr. J. S. Cellier, mining engineer, of Johannesburg, to be professor of mining.

MR. PEASE made his annual statement as President of the Board of Education in the House of Commons on April 10. In the course of his remarks he said that the number of pupils in receipt of free tuition in the 885 secondary schools receiving Government grants last year was 52,563, of whom 49,120 came up from the elementary schools. The staffing of the secondary schools is one teacher to every 32·5; of the elementary schools one teacher to every 13·5. There are twenty training colleges, and their total output of trained teachers last year only reached forty men and 195 women. At the continuation schools only 13 per cent. of the total population under seventeen are in attendance. A course of from two to four years will be established in day trade schools. There is room for twenty more in London and 150 in the country. The 2*l*. 17*s*. per head granted by the Government is wholly inadequate, and Mr. Pease has been able to increase the grant to 5*l*. in land schools and 10*l*. to the various training ships. The Science Museum is about to be built on a site in Exhibition Road, South Kensington. It is proposed to erect the

building in three blocks; the foundations of the first block have already been commenced, and about 110,000*l.* will be spent in the erection. Sir Hugh Bell, Sir Henry Roscoe, and other distinguished men of science have undertaken to advise in connection with the scope of this museum, the organisation of the collection, the policy to be followed in regard to the collection to be placed in the new building, and also as to what should be the relation of the museum to other societies and museums.

The final report of the Royal Commission on University Education in London has just been issued as a Blue-book (Cd. 6717, price 2*s.*). The following are among the principal conclusions and recommendations:—(1) The Commissioners consider the whole organisation of the University fundamentally defective —(*a*) because of the present relations between the internal and external sides of the University; (*b*) because of the existing combination in the University of a large number of institutions differently related to it. (2) They propose that external students should continue to be admitted to the general examinations in the United Kingdom in all degrees except those in medicine and technology. Pupils still at school, however, would not be admitted, and students in constituent colleges or in University departments would not be admitted to these examinations in any faculty in which a special examination was open to them without the leave of the proper University authorities. (3) The University in future would consist of constituent colleges and University departments. The constituent colleges will be institutions either established by the University or existing institutions which are strong enough in one or more faculties to comply with the conditions for incorporation, and which transfer to the University the financial and educational control of their work in one or more of these faculties. (4) The normal portal of entrance to the University would be a school examination, established on the lines recommended by the Consultative Committee, instead of the present matriculation. (5) In order to reconstitute the University on these lines an additional income of 99,000*l.* would be required. We hope to deal further with the report in an early issue.

SOCIETIES AND ACADEMIES.

London.

Royal Society, April 10.—Sir Alfred Kempe, vice-president and treasurer, in the chair.—L. **Hill** and M. **Flack**: The effect of lability (resilience) of the arterial wall on the blood pressure and pulse curve.—Prof. J. H. **Priestley** and R. C. **Knight**: The nature of the toxic action of the electric discharge upon *Bacillus coli communis*. (1) Electric discharge in air is fatal to bacteria exposed to its action. (2) The effect is due to the products of the interaction of the constituents of the air, namely nitric and nitrous acid and ozone. (3) Discharge in air-free hydrogen has no deleterious effect on the organisms, but the presence of small quantities of air allows the formation of a toxic substance, probably hydrogen peroxide, which again exerts a bactericidal action. (4) It, therefore, follows that electric discharges in which the current density does not exceed 10^{-5} amperes per square centimetre do not exert any directly toxic action upon micro-organisms, a result which is contrary to the statements made by some previous investigators.—S. B. **Schryver**: Some investigations on the phenomena of "clot" formations. Part I. The clotting of milk.—Surg.-General Sir D. **Bruce,** Majors D. **Harvey** and A. E. **Hamerton,** and Lady **Bruce**: (1) Morphology of various strains of the trypanosome causing disease in Nyasaland. II., The wild game strain. (2) Morphology of various strains of the trypanosome causing disease in man in Nyasaland. III., The wild *Glossina morsitans* strain. (3) Infectivity of *Glossina morsitans* in Nyasaland.

Linnean Society, April 3.—Prof. J. Stanley Gardiner, F.R.S., vice-president, in the chair.—Prof. A. **Dendy**: The calcareous sponges collected in the Indian Ocean on the Percy Sladen expedition. Of more than 400 species of Calcarea known, the present collection consisted of thirteen species, several of which were new to science.—Dr. J. D. F. **Gilchrist**: Larval stages of *Jasus lalandii* (Milne-Edwards).—R. S. **Bagnall**: The classification of the order Symphyla.

Royal Astronomical Society, April 11.—Major Hills, F.R.S., president, in the chair.—Mrs. **Evershed**: Some types of prominences associated with sun-spots. The paper was illustrated by forty slides of photographs of various forms of prominences situated over sun-spot groups; the photographs were arranged in eleven series, to show the successive changes in individual prominences. Their motions are intermittent, and vary in amount, thus differing from the motions observed in spot penumbræ, which are uniform and constant. The outward moving gas frequently falls back upon the chromosphere, sometimes forming massive banks, and sometimes rising and falling like fountains.—Miss **Blagg**: A suggested substitute for Bode's law. The law itself and the various hypotheses put forward to supplement it were explained. The author's theory agreed much better than Bode's law with the actual distances of planets and satellites; it strengthened the view that tidal action had always been small, and that satellites had not greatly altered their distances.—Joel **Stebbins**: The selenium photometer. The principle of the instrument, which was in use at the Illinois Observatory, was founded on the fact that the electrical resistance of selenium varied when exposed to light. Many irregularities were found in its use as a stellar photometer, but these were reduced by keeping it at a low temperature; about $-20°$ C. was found most convenient.—Dr. F. W. **Dyson**: The distribution in space of the stars of Carrington's circumpolar catalogue.—E. E. **Barnard**: Observations of the variable star 97, 1910 Cygni, at the Yerkes Observatory. The star, which had a period of nineteen or twenty months, was remarkable for its extreme faintness at minimum, when it was beyond the reach of the 40-in. telescope.—H. C. **Plummer**: Preliminary discussion of the galactic motions of the bright stars of type I.—A. C. D. **Crommelin**: Comparison of the moon's coordinates for 1914, according to the new Delaunay tables, with those given in the Nautical Almanac.

Paris.

Academy of Sciences, April 7.—M. F. Guyon in the chair.—J. **Boussinesq**: The application of the formulæ of superficial viscosity to the surface of a spherical liquid drop, falling slowly, with uniform motion in the midst of an indefinite liquid mass in repose and of a density slightly lower than that of the drop.—M. de **Forcrand**: The dehydration and decomposition of the hydrates of uranyl nitrate. The formation of a monohydrate.—Charles **Depéret**: Observations on the geological Pliocene and Quaternary history of the gulf and isthmus of Corinth.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1912. The results are given in three tables showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—Stanislas **Belsetsky**: The stability of equilibrium in a particular case of a piece

with constant curvature.—Emile **Jouguet**: The propagation of deflagrations and the limits of inflammability.—Henri **Chrétien**: A variant of the method of coincidences. In the comparison of two chronometers a curious stereo-acoustic phenomenon was observed by means of which the coincidences of the beats could be accurately observed.—A. **Tian**: A new mode of construction of quartz-mercury vapour lamps. A description of a simple form of mercury lamp, easily constructed in the laboratory out of a small transparent quartz test-tube.—Maurice **Billy**: A simple method for determining the density of mineral powders. The adsorbed air on the particles of powder is replaced by carbon dioxide by evacuating and admitting carbon dioxide to the flask containing the weighed powder. A dilute solution of an alkali of known density replaces the water in the density determination. Any carbon dioxide clinging to the powder is dissolved by the solution. Comparative measurements of the density of a solid before and after powdering showed that the accuracy was of the order of 1 in 3000, or about ten times that of the usual method.—Louis **Dunoyer**: A remarkable case of optical resonance. A description of a resonance phenomenon observed in sodium vapour.—L. **Gay**: The adiabatic expansion of liquids. An account of an experimental method for determining the expansion produced in liquids by adiabatic expansion from 2 to 1 atmosphere.—G. **Wyrouboff**: Some observations concerning the note of Mlle. Feytis on the magnetism of anhydrous and hydrated salts. The author regards a hydrated and dry salt as possessing quite different constitutions, and regards the measurements of Mlle. Feytis as confirming these views.—M. Emm. **Pozzi-Escot**: A new double sulphate of silver and cerium. The new salt has the composition $10Ce(SO_4)_2.6Ag_2SO_4$.—A. **Colani**: The solubility of thorium oxalate. Data are given for the solubilities in hydrochloric and oxalic acids.—Paul **Lebeau** and Marius **Picon**: The action of monosodium acetylene upon the alcoholic iodides. The preparation of true acetylenic hydrocarbons The sodium derivative of acetylene is prepared by the action of acetylene upon sodammonium in solution in liquid ammonia at $-50°$ C. The alkyl iodide is added to this solution and a quantitative yield of the alkylacetylene is obtained. Details of the preparation of allylene and hexine by this method are given.—F. **Bodroux**: Catalytic ester formation in dilute solution; the preparation of ethyl acetate. In presence of a suitable catalyst ethyl acetate is formed from alcohol, and acetic acid in dilute solutions of sulphuric acid.—E. C. **Teodoresco**: The action of high temperatures on dried nucleases of plant origin. The dried nucleases of the three plants studied do not lose all their activity towards sodium nucleate until after thirty minutes' heating to temperatures varying between 141° C. and 162° C.—Maurice **Lenoir**: The commencement of vascular differentiation in the plantule of Veronica.—Marcel **Dubard** and J. A. **Urbain**: The influence of the albumen on the development of the embryo. The albumen is not indispensable to development, but its influence is favourable, especially during the first days of germination.—L. **Armand**: The kinetic phenomena of the heterotypical prophase in *Lobelia erinus*.—M. **Marage**: The inscription of the respiratory movements by means of the hand.—Edgard **Hérouard**: The relations between the depression and formation of the tentacular pseudoplanula in the Scyphistome.—A. **Quidor**: *Lamarckina caligusa* and the evolution of the Lernæidæ.—F. **Picard**: Parthenogenesis in *Phthorimaea operculella*.—Lucien **Cavel**: Sulphur and its variations in the biological treatment of sewage. The determination of combined sulphur in sewage which has passed through various stages of purification throws some light on the proportion of unattacked albumen. The combined sulphur in a sewage effluent should be very small, if the purification has been properly carried out.—M. **Mazé**: The alcoholic fermentation of lactic acid. The organism employed caused the destruction of nearly all the lactic acid present; alcohol and formic acid are the primary products, but the alcohol is acted on and acetic acid formed.—Em. **Bourquelot** and M. **Bridel**: The synthesis of galactosides of alcohols by means of emulsin; β-methylgalactoside and β-allylgalactoside. A description of the preparation and properties of these two galactosides, the latter being new.—Henri **Dominici**, Mme. Simone **Laborde**, and Albert **Laborde**: Study on the injection of radium salts. Radium salts are eliminated from the system with extreme slowness.—Jacques **Deprat**: The succession of the Permian and Carboniferous strata in Indo-China. — Edmond **Bordage**: Researches relating to the extension of the nummulitic sea on the right bank of the Gironde.—A. **Leclère**: The genesis of sedimentary iron minerals.

BOOKS RECEIVED.

Anthropological Report on the Ibo-speaking Peoples of Nigeria. By N. W. Thomas. Part i., Law and Custom of the Ibo of the Awka Neighbourhood, S. Nigeria. Pp. 161+xxx plates. Part ii., English-Ibo and Ibo-English Dictionary. Pp. vii+391. Part iii., Proverbs, Narratives, Vocabularies, and Grammar. Pp. vi+199. (London: Harrison and Sons.)

The Distinction between Mind and its Objects. By Dr. B. Bosanquet. Pp. 73. (Manchester University Press.) 1*s.* net.

Memoirs of the Geological Survey, Scotland. The Geology of Upper Strathspey, Gaick, and the Forest of Atholl (Explanation of Sheet 64). By G. Barrow, L. W. Hinxman, and E. H. C. Craig. With contributions by H. Kynaston. Pp. vi+116+iv plates. (London: H.M.S.O.; E. Stanford, Ltd.) 2*s.*; map, 2*s* 6*d.*

Memoirs of the Geological Survey, England and Wales. (Explanation of Sheet 349.) The Geology of the Country around Ivybridge and Modbury. By W. A. G. Ussher. With a chapter on Altered Rocks by G. Barrow. Pp. vi+137+vi plates. (London: H.M.S.O.; E. Stanford, Ltd.) 3*s.*; map, 1*s.* 6*d.*

Tropical Diseases Research Fund. Report of the Advisory Committee for the Tropical Diseases Research Fund for the Year 1912. Pp. 198. (H.M.S.O.; Wyman and Sons, Ltd.)

Verhandlungen der K.K. Geologischen Reichsanstalt. Jahrgang 1912. No. 1 bis 18. (Vienna: R. Lechner.)

Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band xlvii. Pp. v+309+plates. (Zurich: Zürcher und Furrer.)

Forty-fourth Annual Report of the American Museum of Natural History for the Year 1912. Pp. 208+plates. (New York.)

"Red Books" of the British Fire Prevention Committee. No. 173, Fire Tests with Doors. Reinforced-Concrete Doors. Pp. 28. (London: The British Fire Prevention Committee, 8 Waterloo Place.) 3*s.* 6*d.*

Commercial Gardening. Edited by J. Weathers. In 4 vols. Vol. i., pp. xii+239. Vol. ii., pp. xii+235; vol. iii., pp. xii+240; vol. iv., pp. xii+244. (London: The Gresham Publishing Company.) Four vols., 36*s.* net.

Allen's Commercial Organic Analysis. Edited by W. A. Davis and S. S. Sadtler. Vol. iii. Fourth edition. By the Editors, E. F. Armstrong, G. C. Jones, A. E. Taylor, G. Barger, and others. Pp. xi+563. (London: J. and A. Churchill.) 21*s.* net.

Mitteilungen der Naturforschenden Gesellschaft in

Bern aus dem Jahr 1912. Pp. xlvi+349+3 plates. (Bern: K. J. Wyss.)

Ministère de l'Agriculture. Direction Générale des Eaux et Forêts. 2e Partie. Eaux et Améliorations Agricoles. Service des Grandes Forces Hydrauliques dans la Région des Alpes. Tome v. Résultats des Etudes et Travaux à la Fin de 1911. Pp. 530. (Publisher's name not given.)

A Course of Elementary Workshop Drawing. By H. A. Darling. Pp. vi+172. (London: Blackie and Son, Ltd.) 1s. 6d.

The Origin and Antiquity of Man. By Dr. G. F. Wright. Pp. xx+547. (London: J. Murray.) 8s. net.

The Important Timber Trees of the United States. By S. B. Elliott. Pp. xix+382. (London: Constable and Co., Ltd.) 10s. 6d. net.

The Potato. By E. H. Grubb and W. S. Guilford. Pp. 545. (London: Constable and Co., Ltd.) 8s. 6d. net.

Handbuch der Arbeitsmethoden in der anorganischen Chemie. By Dr. A. Stähler. Erster Band. Pp. xii+786. (Leipzig: Veit and Co.) 25 marks.

Annales de l'Observatoire National d'Athènes. By Prof. D. Eginitis. Tome vi. Pp. 333+plates. (Athens: A. Raftanis.)

Abel's Laboratory Handbook of Bacteriology. Second English Edition. By Dr. M. H. Gordon and others. Pp. xi+251. (London: H. Frowde and Hodder and Stoughton.) 5s. net.

Missouri Botanical Garden. Twenty-third Annual Report. Pp. 207+7 plates. (St. Louis, Mo.: The Board of Trustees.)

L'Uomo Attuale una Specie Collettiva. By V. Giuffrida-Ruggeri. Pp. viii+192+xiii plates. (Milan: Albrighi, Segati e. C.) 6 lire.

Mitteilungen aus den deutschen Schutzgebieten. Edited by Dr. H. Marquardsen. Ergänzungsheft, Nr. 6, Ergebnisse einer Reise durch das Zwischenseengebiet Ostafrikas 1911. By H. Meyer. Pp. iii+127+viii plates. (Berlin: E. Siegfried Mittler und Sohn.) 3.60 marks.

Die antike Tierwelt. By O. Keller. Zweiter Band. Pp. xv+618+2 plates. (Leipzig: W. Engelmann.) 17 marks.

The Continents and Their People. Asia: a Supplementary Geography. By J. F. and A. H. Chamberlain. Pp. vi+198. (London: Macmillan and Co., Ltd.) 3s.

DIARY OF SOCIETIES.

THURSDAY, APRIL 17.

ROYAL SOCIETY, at 4.30.—The Luminosity Curves of Persons having Normal and Abnormal Colour Vision: Dr. W. Watson.—The Reflection of X-Rays by Crystals: Prof W. H. Bragg and W. L. Bragg.—A Fluorescence Spectrum of Iodine Vapour: Prof. J. C. McLennan.—The Relation between the Crystal-symmetry of the Simpler Organic Compounds and their Molecular Constitution. I.: Dr. W. Wahl.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. I. Recent Explorations: Prof. J. Garstang.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on Some Bulgarian Mineral Deposits: H. K. Scott.—Notes on the San Francisco Mill, Pachuca, Mexico: J. P. Holcombe.—Errors in Sampling and Assaying Ores due to the Presence of Coarse Gold: F. White.

ROYAL SOCIETY OF ARTS, at 4.30.—The Burma Oil Fields: N. G. Cholmeley.

LINNEAN SOCIETY, at 8.—An Account of the Plants Collected by Mr. M. P. Price on the Carruthers-Miller-Price Expedition through North-west Mongolia and Chinese Dzungaria: M. P. Price and N. D. Simpson.—The Flora of the Island of Shikotan: Hisayoshi Takeda.

FRIDAY, APRIL 18.

ROYAL INSTITUTION, at 9.—Applications of Polarised Light: Dr. T. M. Lowry.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Presidential Address.—*Discussion:* Volute Chambers and Guide-passages for Centrifugal Pumps: Prof. Gibson.

MONDAY, APRIL 21.

ROYAL SOCIETY OF ARTS, at 8.—Antiseptics and Disinfectants. I.: Dr. D. Sommerville.

VICTORIA INSTITUTE, at 4.30.—The Samaritan Pentateuch, and Philological Questions connected therewith: Rev. J. I. Munro.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Production of Steel Sections and their Application in Engineering Structures: A. T. Walmisley.

TUESDAY, APRIL 22.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems. II.: Prof. W. Bateson.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Weeping God T. A. Joyce.—Prehistoric and Other Antiquities in the Departments of Vienne and Charente, France: A. L. Lewis.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Assuan Dam: Protection of Down-stream Rock Surface, and Thickening and Heightening: M. Macdonald.

ZOOLOGICAL SOCIETY, at 8.30.—The Polyzoa of Waterworks: Dr. S. F. Harmer.—The Marine Fauna of British East Africa and Zanzibar, from Collections made by Cyril Crossland, in the Years 1901-2. Bryozoa—Cheilostomata: A. W. Waters.—Notes on Albinism in the Common Reedbuck (*Cervicapra arundinum*), and on the Habits and Geographical Distribution of Sharpe's Steenbuck (*Raphiceros sharpei*): Major J. Stevenson-Hamilton.

WEDNESDAY, APRIL 23.

ROYAL SOCIETY OF ARTS, at 8.—The Design and Architectural Treatment of Shops: H. V. Lanchester.

GEOLOGICAL SOCIETY, at 8.—The Fossil Flora of the Pembrokeshire Portion of the South Wales Coalfield: H. Goode.—The Halesowen Sandstone Series of the Southern End of the South Staffordshire Coalfield: H. Kay.

AËRONAUTICAL SOCIETY, at 8.30.—Aëroplane Construction: A. R. Low.

THURSDAY, APRIL 24.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* (1) Protostigmata in Ascidians; (2) The Origin of the Ascidian Mouth: A. G. Huntsman.—Experiments on the Kidneys of the Frog: F. A. Bainbridge, S. H. Collins, and J. A. Menzies.—(1) The Probable Value to *B. coli* of "Slime" Formation in Soils; (2) Variation in *B. coli*. The Production of Two Permanent Varieties from One Original Strain by Means of Brilliant Green: Cecil Revis.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. II. Religious Monuments of Asia Minor: Prof. J. Garstang.

SOCIETY OF DYERS AND COLOURISTS (London Secrion), at 8.—The Chemistry of the Vat Dyes: E. de B. Barnett.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Phase Advancing: Dr. G. Kapp.

Work; (3) Standard Connections and Joints in Reinforced Concrete.

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Editorial and Publishing Offices:
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CHEMISTRY OF COAL MINING.

(1) *Coal, and the Prevention of Explosions and Fires in Mines.* By Dr. J. Harger. Pp. vii + 183. (Newcastle-on-Tyne: Andrew Reid and Co., Ltd.; London: Longmans, Green and Co., 1913.) Price 3*s.* 6*d.* net.

(2) *Safety in Coal Mines: a Text-book of Fundamental Principles for Firemen and other Workers in Mines.* By Prof. D. Burns. Pp. vi + 158. (London: Blackie and Son, Ltd., 1912.) Price 2*s.* 6*d.* net.

(1) IN the first of two papers read respectively on February 27 and October 8, 1912, before the Manchester Geological and Mining Society, Dr. Harger expresses his views regarding a means of preventing the occurrence of explosions as follows:—

"The dry mines in this country are more dangerous than they were several years ago, and are likely to become more so in the future if the Government has its way; . . . a reduction of 1 per cent. in the oxygen content, and the addition of ½ per cent. of carbon dioxide in the ventilating current, is all that is required for most mines; and for the more dangerous mines . . . a reduction of 2 per cent. in the oxygen content and the addition of about ¾ to 1 per cent. of carbon dioxide would make the intake airways absolutely safe."

In the second paper Dr. Harger suggests the same means for preventing "gob-fires" (spontaneous combustion). His book is an elaborated edition of both papers, prefaced with some chapters on the nature of coal and its occluded gases, combustion, respiration and the mechanism of explosions.

It is self-evident that if the proportion of oxygen in the air of mines can be reduced in practice to such a point that it cannot support the combustion of either firedamp or coal, neither explosions nor gob-fires could happen. But it is unfortunate that whatever intrinsic value our author's proposals may have—and few would be rash enough at this stage to say they have none—they are based partly upon erroneous impressions regarding the phenomena of great explosions, and partly on the results of what appear to be faulty experiments conducted on too small a scale.

Great explosions do not, as Dr. Harger imagines, travel either exclusively or generally *against* the direction of the ventilating currents; and they do not avoid the working faces or return airways because, as he imagines, the air in these places already contains too little oxygen and too much carbon dioxide to admit of its supporting the combustion of coal-dust.

With regard to the first point, the shot which originated the explosion at Altofts Colliery, to which he refers, was fired in an intake airway at a distance of 550 yards from the bottom of the downcast. The flame traversed all the intake airways but one, at the entrance to which it was arrested by dampness, and in every case (excepting only in the 550 yards) in the *same direction* as the air-currents (Proc. Roy. Soc., vol. xlii., p. 174).[1]

With regard to the second, it was shown (Proc. Roy. Soc., vol. xxviii., p. 416) that return air saturated with, and carrying visible globules of, moisture caught fire at a naked light and burned with a large flame when mixed with a certain coal-dust. That coal-dust came from a colliery adjoining Ferndale, and was of the same quality, so far as volatile matter is concerned, as the *pure* Ferndale dust with which our author failed to get an ignition in his apparatus with normal air. This fact, coupled with the further one that two great explosions have happened at Ferndale colliery—one in 1867 with 178 deaths, the other in 1869 with fifty-three deaths—seems to show that the experiments are not wholly trustworthy, and that some of the conclusions drawn from them as to the quality of air required to prevent ignition will have to be modified.

Dr. Harger proposes to effect his purpose by mixing the necessary proportion of flue gases, which emanate from the boiler furnaces found at every colliery, with the intake air, after having passed them, while still hot, over some catalytic material such as bog iron ore, oxide of copper, finely divided metallic copper, and so on. He contends that if they were thus treated the residual oxygen contained in them would combine with the carbon monoxide, hydrocarbons and smoke, and render them innocuous; and he quotes the authority of Dr. J. S. Haldane and others to show that air of the required quality is not only harmless, but healthful.

His proposals have the distinguishing merit of originality, and have been set forth with such vigorous insistence both in his book and in his papers that they cannot fail to command attention.

(2) This book is designed to meet a want created by the Coal Mines Regulation Act (1911),

[1] Now that this question has assumed some importance it is perhaps rather unfortunate that the Royal Society did not publish the whole of this paper (which is a description of Altofts explosion) as well as the plan of the workings which accompanied it, as some of the misunderstandings and controversies which have arisen during the last twenty-five years might have been thereby avoided.

which provides that, after January 1, 1913, every fireman, examiner, or deputy employed as a fireman, with certain exceptions which need not be here specified, must possess a full certificate stating (1) that he can test for gas with a safety-lamp and is able to see a 2 per cent. "cap," (2) that he can measure an air-current, (3) that his hearing is good.

As a knowledge of the first two requirements cannot be attained by men of this position without tuition, numerous classes have been formed in all the colliery districts for the purpose of instructing them.

Prof. Burns's book is intended to serve as a text-book for these classes, and is, with certain reservations, admirably adapted to its purpose. In attempting to make it suitable to the requirements of both teachers and pupils, however, its author has produced a work which is in some parts too elementary for the former, and in others (indicated by means of asterisks) too abstruse for the latter.

The number of teachers and assistants employed by the education committee of the Glamorgan County Council and the number of candidates who have presented themselves for examination before the same authority during the last eight months are, respectively, eighty-seven and more than 8000. The candidates are thus likely to constitute by far the more numerous class of his readers, and we feel certain that they would much better appreciate the book if those parts of it intended for teachers, together with most of the chemical and other formulæ, descriptions of methods of preparing methane and other gases, and all the more complicated exercises, were omitted. We therefore recommend Prof. Burns, when preparing another edition, to avoid the solecisms which abound in the present book, to eliminate all but the simple matter suitable to the capacity of firemen—which we have no hesitation in pronouncing to be excellent in its present form—and, if he thinks it desirable or necessary, to write another more advanced book for the use of teachers and others.

SOUTH AFRICAN ARCHÆOLOGY.

The Pre-historic Period in South Africa. By J. P. Johnson. Second edition, revised and enlarged. Pp. iv+115+plates+map. (London: Longmans, Green and Co., 1912.) Price 10s.

It is satisfactory to find that there is a sufficient interest in the subject of South African archæology to require a second edition of Mr. J. P. Johnson's book on "The Pre-historic Period in South Africa" within two years. In the new edition some new finds are referred to, and there is an appendix by Mr. A. S. Kennard on the sequence of the stone implements in the Lower Thames Valley. Mr. Johnson describes and figures chipped stones from Leijfontein, below the Campbell Rand, which closely resemble those from the plateau of Kent, and he does not hesitate to call them "eoliths." Implements of river-drift types are distributed all over South Africa. "Among the amygdaliths [his term for the common type of implement] every gradation is met with between the thick Chelléen form with unworked butt, the thinner Acheuléen type with edge carried all round, and the proto-Solutréen form pointed at both ends"; he calls them all "Acheulic." He also recognises "Solutric" implements; amongst these are "pigmy implements" of chert. Dr. Péringuey found implements at Bloemsbosch in what Johnson considers a Solutric site, apparently contemporary with a large extinct buffalo and horse. In the present state of our knowledge it is rather begging the question to apply without qualification to South African finds the terms used to designate special "industries" of European archæology. It would be a wiser plan to use non-committal designations while pointing out the similarities in the forms of the implements.

The Coast middens described by Dr. Péringuey are referred to, and several excellent reproductions are given of petroglyphs and rock-paintings, the peckings made by the Bantu being markedly inferior to Bushman work. The upper drawing of his Fig. 37 is of a rock-painting described by G. W. Stow in "The Native Races of South Africa" (p. 121). Mr. Johnson has no doubt that the "Solutric" implements were made by the ancestors of the present Bushmen, who, he believes, were very far from being a homogeneous people. Prof. Sollas, in "Ancient Hunters and their Modern Representatives," regards it as highly probable that in Aurignacian times a race allied to the Bushmen inhabited western Europe (p. 268). Mr. Johnson, however, seems to class the Aurignacian, Solutrian, and Magdalenian stages under the term Solutric. Support is given to the view that the famous forts or kraals and other ruined structures in Rhodesia were built by prehistoric Bantu in connection mainly with gold-mining, and he supplies plans of four stone-walled ruined kraals at Ramoo Kop for comparison with those already published.

ASPECTS OF THE EARTH.

(1) *Lehrbuch der Grundwasser- und Quellenkunde.* Für Geologen, Hydrologen, Bohrunternehmer, Brunnenbauer, Bergleute, Bauingenieure und Hygieniker. By Prof. K. Keilhack. Pp. xi + 545. (Berlin: Gebrüder Borntraeger, 1912.) Price 20 marks.

(2) *The Geology of Soils and Substrata.* With Special Reference to Agriculture, Estates, and Sanitation. By H. B. Woodward. Pp. xvi + 366. (London: E. Arnold, 1912.) Price 7s. 6d. net.

(3) *Die erklärende Beschreibung der Landformen.* By Prof. W. M. Davis. Deutsch bearbeitet von Dr. A. Rühl. Pp. xviii + 565. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 11 marks.

(1) PROF. KEILHACK has produced a book on water-supply which presents a remarkable contrast with the brief treatment of the subject in many works on engineering. Yet he regards these five hundred tall and handsome pages as constituting a preliminary "Lehrbuch," leading up to a future "Handbuch" of Teutonic magnitude. The geologist here subordinates himself willingly to his technical purpose. The kinds of rocks are dealt with in a few short sentences, but their structure and the passage-ways for water in them are at once impressed upon the reader as of paramount importance. The characters of soils as water-bearers receive rather slight attention, and the necessity for discriminating between the "fine earth" used experimentally and the soil as part of the earth's crust, with all the stones in it, seems left to the intelligence of the reader.

In all questions involving maps Prof. Keilhack is on ground that is specially his own, and he makes good use of the beautiful products of the Prussian Geological Survey. The discussion of the form of the surface of the subterranean water-table is unusually detailed. The problems of the European karstlands are considered; but the author probably leaves for his still larger treatise the interesting feature of water-supply in more arid countries, such as rivers disappearing into sandy wastes, the origins of oases, and the salts deposited in the surface-zone of excessive evaporation. Prof. Keilhack's book is an excellent example of the application of scientific research, wide and without ulterior motive, to the stimulating needs of human enterprise.

(2) Mr. H. B. Woodward's latest addition to Arnold's Geological Series is an attempt to look at soils from a geological point of view, and at the strata below them from the attitude of an agriculturist. The proper treatment of the soil is rapidly becoming a matter for the organic chem[ist] and the biologist, but the foundation on which t[he] soil-activities are based is an aggregate of mine[ral] particles spaced in very various ways. The so[il-]forming minerals are rather briefly treated o[n] pp. 55–6, and the calcium fluoride and chlori[de] of apatite have somehow got attached to dolomite. The beneficial character of some of these minerals and the deadly effect of others are not indicated at this stage; but we find a good deal of diffused information when we reach the accounts of soils formed on various types of rock. The vexed question of what is "clay" is left alone, but we may hesitate to accept the statement (p. 78) that the Kimeridge, Gault, and London Clays contain "up to 95 per cent. clay." The remark on p. 73 that "alumina, in the form of silicate of aluminia or clay," absorbs and retains moisture and serves as a binding material does little to help us towards understanding the rock known as clay. Analyses of the clays mentioned above, moreover, are given on p. 59, and show at the most 50 per cent. of aluminium silicate.

If we feel that the first part of the book does not quite realise the author's aim, and does not explain the soils and their structures to an agriculturist as a geologist might explain a landscape to a painter, the latter section will convey much special information to landowners in the British Isles. The soils on the subdivisions of our stratified series are described by one who knows their aspect well, and these chapters form a general account of the superficial deposits of England, with many useful notes on those of Scotland and of Ireland.

(3) Prof. W. M. Davis has always a question to ask which must be answered in the field itself. At times he may seem to ignore the mineral details which lie at the root of rock-structure, and therefore at the root of the features produced during a cycle of erosion. But he rightly, on p. vii. of the present work, distinguishes between geological and geographical description; in the latter, all attention must be concentrated on the surface-forms as they are to-day. The lectures delivered in German by Prof. Davis in 1908–9 at the University of Berlin are here presented, with the assistance of Dr. Rühl, as a general treatise on land-forms. They are illustrated by the author's line-drawings, minute and thoughtful, like the work of Albrecht Dürer, and sometimes presenting, as the earth does, too many problems in the limits of a single scene.

Anyone who examines these drawings will be made to understand features that he remembers viewing casually, perhaps even from a railway train; and now for the first time he perceives

them in their true relations. The dissected highland of fig. 116, with the broad cone of detritus forming the only habitable region at its foot, will remind the traveller of the valley of the Inn or of the Drau. The volcanic relics in fig. 132 explain Gergovia and Mont Dore. The eighth chapter, on "Der aride Zyklus," appeals strongly to pioneers on the edges of our colonised lands, and would have edified the Roman senate, when it republished the Carthaginian text-books and faced the problems of the desert and the steppes. On pp. 375–6 the evidence for a recent uplift of central and southern Africa is well stated. A characteristic discussion on the methods of presenting geographical problems finds its way somehow into this chapter. British geologists will turn with interest to the chapters on glacial conditions and marine erosion. The explanation of the features of the coast of south Devon on p. 502, which seems at first somewhat complex, is fully justified when we realise that the "soft rocks" postulated really exist in the form of Cretaceous and perhaps Eocene limestones beneath the English Channel.

The disguise of Prof. Davis as a Prussian is a thin one. Who does not recognise him in the brilliant description of the Roman area on pp. 393–4, which is to occupy four minutes of oral instruction; or in the terrifying discovery on p. 398 that every land-form can be treated geographically in four-and-fifty different ways?

GRENVILLE A. J. COLE.

OUR BOOKSHELF.

The Manufacture of Iron and Steel: a Handbook for Engineering Students, Merchants, and Users of Iron and Steel. By H. R. Hearson. Pp. xi+103. (London: E. and F. N. Spon, Ltd., 1912.) Price 4s. 6d. net.

THIS small volume is obviously primarily intended to give engineering students an outline of the manufacturing operations of iron and steel, and also an idea of the chemical characteristics and the mechanical properties of the finished products. The author has undoubtedly, to a great extent, produced a lucid and useful little text-book.

After a preliminary chapter on elements, the blast furnace is considered, being followed by a short chapter on wrought iron. Steel is next dealt with, including the Bessemer, Crucible, and Siemens methods. The book has so much valuable and accurate information that it may be of very great use to elementary students of iron and steel metallurgy, but several remarkable errors should be revised in any future edition. For instance, on page 37, steel containing 0·3 per cent. of carbon is classified as medium instead of mild, and steel containing 0·7 per cent. of carbon is designated hard instead of medium. In describing the manufacture of "blister steel" by cementation, the author states, "None of the bars is carburised right through to the centre, so the centre still remains as iron." This is true of, say, No. 2 bars, but high-number bars are always "steel through." Some of the paragraphs on crucible steel also need serious revision; for instance, the curious assertion that if kept too long in the furnace the steel will become brittle by taking up too much silicon from the crucible. Mr. Hearson also revives the obsolete dictum that mild steel is crystalline and wrought iron fibrous. On page 77 the somewhat astounding information is given that the top of an ingot may be prevented from rapidly solidifying by covering the top with sand. The chapter on the mechanical testing of steel is excellent, but in the brief final chapter dealing with the heat treatment of steel many metallurgists will be surprised to learn that steel containing 0·25 per cent. of carbon becomes "hard" on quenching, and the paragraphs on hardening are out of date. If carefully revised, however, the book will become of distinct value.

J. O. A.

Photochemische Versuchstechnik. By Dr. Johannes Plotnikow. Pp. xv+371. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1912.) Price 11 marks.

THIS book forms the complement of a previous volume by Dr. Plotnikow on the theory of photochemistry ("Photochemie," W. Knapp in Halle a.S., 1910). In the present work he describes at length the apparatus and the experimental methods used in photochemical research. Part i. contains a useful summary of the characteristics of the various sources of light that may be employed. The mercury arc lamp, in which a steady electric current is passed through the vapour of mercury in a highly exhausted tube of Uviol glass or of fused quartz, is recommended as providing a constant and trustworthy source. Other sources discussed are the arc and spark between metal terminals, the carbon arc, the Nernst lamp, and the Röntgen ray tube. In part ii. Dr. Plotnikow describes the construction of the special forms of thermostat which he has devised for photochemical experiments, and enumerates a number of solutions that may be employed as light filters with the mercury vapour lamp in order to give approximately monochromatic light.

Part iii. contains an account of the instruments used in optical measurements, including photometers, spectrophotometers, spectrometers, refractometers, and polarimeters.

In part. iv. the author describes a number of interesting lecture experiments for illustrating the fundamental laws of photochemical reactions, the various phenomena of luminescence, and the principal facts of photoelectricity. It is satisfactory to find attention directed to the subject last named, since the separation of negative electrons under the influence of light probably forms the clue to the understanding of the mechanism of all photochemical processes.

Part v. contains a collection of tables likely

to be useful in photochemical work. The values of the function e^{-x} are tabulated in thirteen pages from $x=0$ to $x=10$, and fifty-six pages are assigned to tables by Dr. N. Rosanow showing the reciprocal of the wave length and the frequency for every Ångström unit from λ 2000 to λ 8000.
H. S. A.

The Economics of Everyday Life. Part i. By T. H. Penson. Pp. xiv+174. (Cambridge University Press, 1913.) Price 3*s.* net.

IT is surprising how difficult it apparently is to write a good short text-book of economics, but Mr. Penson has been eminently successful in doing so. He has fully grasped the fact that the first need for such a book is to be simple and elementary as well as short. Where possible, he rightly prefers the ordinary terms of everyday use to the technical phrases of economics. For instance, instead of production, exchange and distribution, he talks of the "source of income," "buying and selling," and the "individual income." These, in my opinion, are far more intelligible to the beginner. Moreover, his definitions are nearly always both clear and adequate, those of demand and supply affording a good example.

The method of treatment follows, on the whole, that of the modern school, of which Prof. Marshall may be regarded as the head, and exchange is treated before, and not after, distribution. The subjects of consumption, taxation, trade unions and cooperative societies are left to the second part of this book, which has yet to be published.

The present volume clearly marks Mr. Penson as possessing great capacity as a teacher. He chooses wisely not only his terms, but the subjects of which he treats. Omitting nothing that is essential, he has avoided thorny and difficult subjects likely to confuse the beginner. His definitions, too, are both concise and complete. A new and valuable feature of the book is found in the simple tables and diagrams by which the argument is rendered easy to understand, but mathematical methods are rigidly, and in such a book rightly, avoided. Occasionally, however, the author treats unimportant matters somewhat too fully. Usually he is neither too long nor too short, but, like Sidney Godolphin, "is never in the way, and never out of it."
N. B. DEARLE.

Dent's Practical Notebooks of Regional Geography. By H. Piggott and R. J. Finch. Book i., The Americas. Pp. 64. (London: J. M. Dent and Sons, Ltd., 1913.) Price 6*d.* net.

IF every geography teacher set the same practical exercises, this conveniently arranged notebook would have a wide circulation; but naturally a teacher's exercises should reflect his own individuality. The little book may be commended, however, as affording a good example of the way in which pupils can be led to acquire an intelligent knowledge of geography as the result of their own activities.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

An Application of Mathematics to Law.

I HAVE attempted to apply mathematical symbolism to some of the difficult problems of patent law. The question to be decided by the Court in a patent law suit is usually this: assuming that the alleged invention deals with "a manner of manufacture" (*i.e.* is, or yields, something concrete), was there ingenuity and utility in the step from what was already known? Ingenuity means inventive or creative ingenuity as apart from the normal dexterity of the craftsman, which of itself is insufficient to support a patent, as otherwise patents would unduly hamper industry. It will be seen at once that it is a most subtle question for any court to determine whether a given act, the selection of one out of many alternatives, the assemblage of various old elements, the adaptation of old elements to new uses—whether such an act is one which calls for ingenuity as apart from the expected skill of the craftsman.

To express the problem symbolically I will start from an admirable dictum of Lord Justice Fletcher Moulton (Hickton Pat. Syn. *v.* Patents Improvements). He stated that invention might reside in the idea, or in the way of carrying it out, or in both; but if there was invention in the idea plus the way of carrying it out, then there was good subject-matter for a patent. I express this by representing any idea as a functional operator, and the way of carrying it out (*i.e.* the concrete materials adopted) as a variable. Calling result I:

$$I=f(x).$$

Here I represents what the Germans call the "technical effect" of the invention, or what Frost calls the manufacturing "art," and we see at once that a patent cannot be obtained for a mere principle or idea (f, which is not concrete) unless some way of carrying it out (x) is also given. But the invention may reside either in f or in x.

Let us express in general terms a manufacture (M) which is not an invention. We will use f to represent a known operator or idea, ϕ to represent a new operator or idea. a, b . . . will represent known variables, ways of carrying out an invention (*e.g.*, valves, chemical substances, &c.), and $x, y,$ new variables.

It is obvious that $f(a)$ is not an invention, nor will it normally be an invention to add $f(b)$ to it. Moreover, the craftsman is not to be tied down to this. He is at perfect liberty, within limits, to make variations in his variables, to alter the size of a crank, to substitute one alkali for another, and so on; in other words, he can take $f(a+\delta a)$.

Generalising, we may say:

$$M=\Sigma f(a+\delta a).$$

Developing this by Taylor's theorem, and proceeding from an infinitesimal to a finite change, we have, neglecting quantities of the second order:

$$M=\Sigma f(a)+\Sigma \delta f(a).$$

This is the general equation for a manufacture which is not an invention. To be an invention, ingenuity (i) must be involved.

$$I=M+i \text{ or } I=\psi(M),$$

thus:

$$I=\psi[\Sigma f(a)+\Sigma \delta f(a)]=\Sigma f(a)+\Sigma \delta f(a)+i.$$

I will now consider in various actual examples the nature of ψ, the inventive function, and of i, the inventive increment.

One of the commonest cases in which a decision is necessary is that of a combination. Suppose that $f(a)$ and $f(b)$ are old: will there be invention in combining a and b?

The answer is this:

$$(1)\ I=f(a, b)$$
$$(2)\ M=f(a)+f(b)$$
$$(3)\ I=M+i.$$

If the result of the combination is given by (1), there is an invention; this is termed a "combination." If the result is given by (2), there is no invention; this is termed an "aggregation." It is interesting to compare this definition with one given by Lord Justice Buckley (Brit. United Shoe Mach. Co. *v.* Fussell) of a "combination" as "a collocation of intercommunicating parts, with a view to obtaining a simple result."

An example of a true "combination" is found in the case of Cannington *v.* Nuttall, in which a patent was upheld for a glass furnace, although each and every part (a, b, c) had been employed before in glass furnaces (employment $=f$). But, owing to the combination, and the co-operation of the parts, a new result was obtained.

$$I=f(a, b, c)=f(a)+f(b)+f(c)+i.$$

On the other hand Bridge's case is an example of an aggregation; in fact, a patent was refused by the Law Officer, showing that the case was considered absolutely devoid of invention. The alleged invention consisted in the employment in a shutter for dividing-up rooms (f) of means (a) to guide the shutters along the floor, and cogs (b) to hold the shutters against the wall. $f(a)$ and $f(b)$ were both old, and no new result flowed from their juxtaposition. Hence $M=f(a)+f(b)$: there was no invention; each part simply played its own rôle, and there was no interaction.

Another type of invention is that of varying proportions in a known combination. Here, if $M=f(a, b, c)$, and if there is a maximum at one value or range of values of c, invention may be involved. The maximum relates to the technical effect, and may be with respect to efficiency, economy, &c.

Thus if $\frac{\partial f(a, b, c_1)}{\partial c}=0$ at the value c_1, the function will be a maximum or a minimum and there may be an invention. This will not be the case if $\frac{\partial f(a, b, c_1)}{\partial c}\neq 0$. Other singular points may be inventions, *e.g.* where $\frac{\partial f(a, b, c_1)}{\partial c}=\infty$ (discontinuity), or where $\frac{\partial^2 f(a, b, c_1)}{\partial c^2}=$ (kink in the curve). This also holds for a range of values from c_1 to c_2.

Examples of the application of this equation are to be found in the cases of Edison *v.* Woodhouse, and Jandus Arc Lamp Co. *v.* Arc Lamp Co. In Edison's case f represented the employment in an incandescent lamp of an exhausted glass vessel (a), leading-in wires (b), and a carbon filament (c_1). $f(a, b, c)$ was known, but it had never been proposed to use a very thin carbon conductor or "filament." Here, owing to the high resistance and flexibility of the filament, the efficiency was a maximum:—

$\frac{\partial f(a, b, c_1)}{\partial c}=0$, and the choice of this value c_1, which made the difference between failure and success, was held to be an invention.

In the Jandus Arc Lamp case, f represented the employment in an arc lamp of carbons (a), a tightly fitting sleeve (b), and an envelope of glass, &c. (c), inside the outer globe. By making the glass envelope 3 in. in diameter a maximum efficiency was obtained, and on this ground the patent was upheld, although envelopes had previously been made 9 in. in diameter. Here again:

$$\frac{\partial f(a, b, c_1)}{\partial c}=0 \text{ when } c_1=3 \text{ in.}$$

A further example is an old case (Muntz *v.* Foster) in which a sheathing for ships was made of sixty parts of copper (a) and forty of zinc (b).

Alloys of copper and zinc had been used before in about the same proportions, but in this case the same result would not have been attained, because Muntz specified the best selected copper and highly purified zinc. The impurities (δx) were of great and unsuspected importance. Moreover, other alloys of copper and zinc (probably even of purified metals) had been made. We may consider the two points separately.

(1) Impurities:—

$f(a+\delta x, b+\delta x)$ was old, where δx represents impurities. Muntz's alloy was $f(a, b)=f(a+\delta x, b+\delta x)+i$, hence there was an invention.

(2) Selection of 60 : 40 percentage:—

$\frac{\partial f(a_{60}, b_{40})}{\partial a}=0$ since at this percentage the efficiency was a maximum, because the alloy oxidised just fast enough to prevent barnacles adhering to the ship, but not fast enough to waste away excessively.

On the contrary, the case of Savage *v.* Harris was one in which there was held to be no invention in changing the size of part of a device for retaining ladies' hats in place. There was a back portion (a) and teeth (b), and the size of the back was altered:—

$\frac{\partial f(a_1, b)}{\partial a}\neq 0$, and there was no invention.

A known device or material (a) may be employed for a new purpose (ϕ). If $f(a)$ is the old use, and $\phi(a)$ the new use, we have for an invention $I=\phi(a)=f(a)+i$. But if $M=\phi(a)=f(a)$, there is no invention. The oft-quoted case of Harwood *v.* Great Northern Railway Company was one of the latter type. Fishplates (a) had been used for connecting (f) logs of timber, and it was held there was no invention in applying them (ϕ) to rails in which they acted in the same manner:-

$$\phi(a)=f(a).$$

But in Penn *v.* Bibby, wood (a) was employed (ϕ) for the bearings of propellers in order to allow the water to pass round the friction surfaces. Wood had previously been employed (f) in water-wheels, but $\phi(a)=f(a)+i$, and it was held that there was invention.

A similar type of invention is that in which different materials are employed in the same process. Here $f(a)$ is old, and $f(x)$ is new. If $f(x)=f(a)$ there is no invention. If $f(x)=f(a)+i$ there is invention. In the recent case, Osram Lamp Works *v.* Z Lamp Works, a patent was upheld for the use (f) in incandescent filament lamps of tungsten (x), though osmium (a) was known. Tungsten was more efficient and cheaper:—

$f(x)=f(a)+\delta i$, where δi represents a small degree of invention. This in itself might not have been sufficient, but it was coupled with the fact that one particular process of removing the carbon from the filaments was selected out of three known processes. This may be considered to require an amount of ingenuity Δi. $\delta i+\Delta i=i$, and therefore $f(x)=f(a)+i$, and there is invention involved.

Another type is the omission of one step in a known process. In the case of Badische Anilin- und Soda-Fabrik *v.* Soc. Chim. des Usines du Rhône, it was

held that there was subject-matter in such an omission. A process had been proposed for preparing dyes called anisolines (A) from rhodamines (r) by first forming a potassium salt (1st step$=f$), and then transforming this salt into anisoline (2nd step$=$F). Thus the known process was:—

$$A=F[f(r)].$$

Now it was shown that the potassium salt did not exist, *i.e.* $f(r)$ was imaginary; the patent in question obtained anisoline direct from rhodamine, $A=f(r)$, and this was held to be an invention.

I may note two final points. When a patent is granted, the criterion of ingenuity is not applied, as this is left for the Court to determine. However, if there is absolutely no ingenuity possible, the Law Officer may refuse to grant a patent. His criterion of rejection is, therefore, not $f(x)=f(a)$, as in the Court, but $f(x)\equiv f(a)$.

A patent is invalid for "insufficiency of description" if it casts on the public the burden of experiment beyond a certain point. This may be expressed by saying that in this case the equation $I=\phi(a)$ is indeterminate. HAROLD E. POTTS.

University Club, Liverpool, April 2.

A University in the Tropics.

THE importance and value of the establishment of a university in the tropics can only be appreciated fully by those who, trained in the universities of Europe, are suddenly brought face to face with the unfamiliar conditions obtaining in a tropical country. That the proposition may be thoroughly considered and eventually realised must be the wish of all interested in the development of our tropical possessions.

The question of a site for an imperial tropical university is one upon which divergent views may be expected; few men know the equatorial belt with uniform intimacy, and are liable in consequence to be prejudiced in favour of one part or another. Admitting my own imperfect knowledge, I would like to bring forward the claims of British East Africa as an eminently suitable situation for such a university.

Dissected by the equator, it cannot be equalled for position in British territory. Rising from sea-level to plateaus more than 8000 ft. in altitude, with a mountain rising more than 17,000 ft., far above the snowline; with heavy rainfall in one part and almost rainless deserts in another; with healthy districts and parts uninhabitable by man in consequence of deadly diseases; with soils varying from coral through sands to loams and clays; with standard crops from cocoanuts, rubber, and cotton, to coffee, maize, and wheat; with a large native population possessing many different languages and customs; with a flora and fauna as diversified as climate and altitude, and probably as varied as is to be found in any country; with a geological structure presenting some of the most interesting features in the world—British East Africa, the only British territory through which the equator passes, is surely uniquely situated for the seat of an imperial tropical university for the study and advancement of our knowledge of medical, agricultural, botanical, zoological, anthropological, ethnological, and other branches of science.

The capital of the country, Nairobi, is situate within 100 miles of the equator, is in a healthy district, is twenty-four hours by rail from the coast tropical belt, and the same distance from the Victoria Nyanza and Uganda, both full of the most diverse subjects of scientific interest.

The proximity of India is another great advantage in this respect. Practically all the natural conditions obtaining there—even acquaintance with the natives and their languages—may here be studied while residing in a climate resembling an English summer.

If any more suitable position for an imperial tropical university can be found than Nairobi, then the British Empire is indeed most fortunate, but a glance at the map does not suggest the possibility of such a collection of favourable factors occurring elsewhere. The passage is seventeen days, with choice of five steamship lines. U. H. KIRKHAM.

Government Laboratory, Nairobi, February 24.

The Twinkling of Stars.

IN three papers in *The Journal of Physiology* I have described a number of new visual phenomena which show that the photochemical stimulus is situated externally to the cones, and that the foveal region is sensitised from the periphery of the retina. The result of this is that at one moment the foveal region may be the most sensitive part of the whole retina, and at another blind. The twinkling of stars may be imitated in the dark-room. If a small light be looked at in a dark-room, as, for instance, that coming through the smallest diaphragm of my colour perception lantern, which represents a 5½ in. bull's-eye railway light at a thousand yards when seen at a distance of 20 ft., care being taken not to move the eye, the light will appear to twinkle like a star. It will be noticed that pale bluish-violet circles start at the periphery of the field of vision, and, gradually contracting, reach the centre. On reaching the centre the light brightens. If the circles stop the light disappears. The colour of the circle is the same for white light or any colour.

There is another simple experiment which shows how the centre of the retina is sensitised from the periphery. On opening one eye on awaking in the morning and looking at the ceiling, the central portion is seen as an irregular, circular, rhomboidal, or star-shaped black spot. On closing the eye again a bluish-violet circle appears at the periphery or middle of the field of vision, contracts, and then, after breaking up into a star-shaped figure and becoming brighter, disappears, to be followed by another contracting circle. If the eye be opened when the star figure has formed in the centre it will appear as a bright rose-coloured star much brighter than any other part of the field of vision. If, however, we wait until the star has broken up and disappeared before opening the eye, it will be found that only a black spot is seen in the centre. F. W. EDRIDGE-GREEN.

London, April 14.

Gain of Definition obtained by Moving a Telescope.

A SLIGHT adaptation of the explanation offered by your correspondent Mr. G. W. Butler (April 10, p. 137) appears to furnish a more natural solution of the problem. When an object at rest is seen against a background which it closely resembles there is nothing to differentiate between the object and the slight irregularities of the background. So soon as the object moves, such a differentiation becomes possible, the moving irregularities being now attributed to their real origin. It seems unnecessary to assume a "cumulative impression of contrast."

The following simple experiment lends support to this explanation. A small opening is cut in a sheet of paper covered with irregular markings, such as ink dots. Against the back of this is held another sheet similarly marked. If now the sheets are observed from such a distance that the edges of the opening are invisible, its position cannot be determined

except by sliding one sheet over the other, when the motion of some of the dots with respect to the others immediately betrays its situation. R. S. Capon.

Oxford.

Mr. M. E. J. Gheury concludes a note in the issue of Nature of March 27, relating to the gain of definition obtained by moving a telescope, with the words: "Perhaps some of your readers have noticed something similar and could throw a little light on this mysterious phenomenon."

By a curious coincidence "something similar" did come to my notice just one day previous to my reading of Mr. Gheury's note. I do not propose to throw any light on the question, nor do I wish to imply that there is anything more than an accidental and external similarity between the two cases in question. But it may not be out of place to direct attention to a peculiar observation recorded in *The Mechanic's Magazine* of the year 1829, and rescued from oblivion in a recent number of the German periodical *Prometheus*. The experiment is extremely simple, and can be repeated by anyone with the very simplest materials.

Take a piece of paper of such thickness that when it is laid over a sheet of printed matter the characters just show through but cannot be read. Place this over a page of printed characters, move it about with a circular motion, and you will no doubt be surprised to find that now the print shows through and can be read with comparative ease. It is, of course, necessary to adjust the thickness of the paper and the size of the type, but two or three trials are sufficient to determine the right conditions for the experiment.

Alfred J. Lotka.

New York, April 11.

THE NEW SEISMOLOGY.

For very many years past in Italy, and to a lesser extent in other countries, earthquakes had been recorded, while a few private individuals collected and analysed earthquake statistics. These, however, were the days of seismoscopes and the old seismology. The new seismology did not come until macroseisms had been measured and teleseisms had been discovered. With their arrival new lines of physical, and particularly geophysical, research were opened for exploitation. Commencing in Japan, the desire to record and discuss the felt and unfelt palpitations of our earth spread like an epidemic round the world. In 1880 the Seismological Society of that country was founded, and the twenty volumes which it issued contain initiatives for very many of the investigations carried out since that date. When this society ceased to exist the Japanese Government established an Earthquake Investigation Committee, which up to date has published more than eighty quarto volumes.

In the early days attention was first directed towards obtaining instruments which would give actual measurements of earthquake motion. Steady-point instruments were devised, and, for earthquakes we feel, are now in use throughout the world. From a knowledge of the actual nature of earthquake motion derived from these instruments, new rules and formulæ for the use of engineers and builders were established. To test the suggested new departures in building and engineering practice, structures in brick and other materials were fixed upon platforms actuated by powerful machinery and subjected to movements closely corresponding to those of heavy earthquakes. The results of these investigations in Japan and other countries have been extensively applied in the construction of piers for bridges, tall chimneys, walls, ordinary dwellings, embankments, reservoirs, &c. Inasmuch as the new types of structure have for very many years withstood violent shakings, while ordinary types in their neighbourhood have failed, it may be inferred that much has already been accomplished to minimise the loss of life and property.

The application of seismology to the working of railways, particularly in Japan, led to the localisation of faults on lines, and alterations in the balancing of locomotives. The result of the latter has been to decrease the consumption of fuel.

Later, instruments were devised to record earthquake motion which cannot be felt, with the result that a person living in any one part of the world can record and obtain definite information about any *large* earthquake originating even so far off as his antipodes. These records of the unfelt movements of earthquakes have from time to time indicated the position, the time of occurrence, and, what is of more importance, also the cause of certain cable interruptions. The practical importance of this latter information, especially to communities which may by cable failures be suddenly isolated from the rest of the world, is evident.

The many occasions on which earthquake records have furnished definite information respecting disasters which have taken place in distant countries, corrected and extended telegraphic reports relating to the same, is another illustration of the practical utility of seismic observations. Seismograms have frequently apprised us of sea waves and violent earthquakes in districts from which it is impossible to receive telegrams, while the absence of such records has frequently indicated that information in newspapers has been without foundation or at least exaggerated. Localisation of the origin of these world-shaking earthquakes, besides indicating sub-oceanic sites of geological activity, indicates positions where the hydrographer may expect to find unusual depths. They have also shown routes to be avoided by those who lay cables.

Seismograms of unfelt movements throw light upon what have but recently been regarded as unaccountable deflections in the photograms from magnetographs, barographs and other instruments sensible to slight displacements. They have also explained unusual rates in certain timekeepers.

Among the very many scientific results which the new seismology has contributed to science is that it has given us the velocities at which motion is propagated in various directions through the world. Until these observations had been made our knowledge respecting the interior of the earth

chiefly related to its density and temperature. Now we know much respecting its rigidity.

With the object of increasing our knowledge of teleseismic disturbances, in 1896 the British Association, with the assistance of the British Government, communicated with many foreign States and Colonies suggesting that they should establish a certain type of seismograph. The result has been that the British Association now enjoys the cooperation of fifty-nine similarly equipped stations which are fairly evenly distributed over the world. The general outcome from this and the work carried out in Japan is that nearly every civilised country in the world has had its attention directed to this new departure in geophysics and has established seismographs.

In the last-mentioned country observers are to be found in most towns, and many instruments have been installed to record macroseisms and teleseisms. The annual outlay for earthquake work in that country is about 5000*l.* Russia, for the support of a system extending over its vast territories, expends a similar amount. Italy, which is the oldest country for recording earthquake phenomena, is covered with stations. Austria, France, Switzerland, Chile, the United States of America, the Balkan States and the small States of Central America each have their organised systems, while in Germany we find the headquarters of the International Seismological Association. This is supported by yearly contributions of about 1600*l.* from twenty-two countries. The headquarters of this body is in Strassburg, but it also controls stations in Beirut and Reykjavik. In Great Britain teleseisms are now recorded in thirteen different places. Three of these stations are owned by private persons, but the one in the Isle of Wight is largely supported by grants from the Royal Society, the British Association and Mr. M. H. Gray. The remaining nine are attached to existing observatories or other institutions.

J. MILNE.

THE PROBLEM OF TUBERCULOSIS.

THE final report of the Departmental Committee on Tuberculosis was recently published. Since the interim report of 1912 (April) was issued the committee has been engaged in devising methods for dealing with the general problem of tuberculosis as it affects the community. This introduces at once the difficulty as to the policy to be followed with those cases occurring among the non-assured under the National Insurance Act. The funds for this purpose are now promised by the Government up to one half of the estimated cost, and whilst giving the ratepayers control of the local administration the funds mentioned are to be drawn from national sources.

Dr. Newsholme has shown how largely the improvement recorded in respect of this disease is really due, not so much to successful treatment, but more to the segregation of the advanced cases in special institutions, chief among these being those wards of the Poor Law infirmaries set apart as sanatoria. But the law has till now left (and still leaves) the patient the right to "claim his discharge" when he pleases, and this is frequently exercised to his own detriment; but the committee now realises that, in addition, he is a source of danger to others in his environment. On this ground it is proposed to withdraw this liberty from the class of infective "ins and outs." It is a noteworthy point that the tuberculosis of children is now accepted by the committee as mainly of bovine origin.

The outstanding feature of the report is that of the provision for research, and its recognition in a fuller sense than has yet found its way to the statute book. The committee computes that an income for this purpose will accrue under the Insurance Act of about 57,000*l.* a year, and it proposes the establishment of various grades of research workers, to include the appointment of full-time men, who shall entirely devote themselves to research "at an adequate salary," with a subsequent pension.

The outline of a detailed scheme is given which includes the use of existing agencies, but contemplates also the formation of a central bureau with an expert secretary director at the head. This is primarily designed for the reduction of statistics to comparable form, and may comprise a research institution as well.

In view of the scattered distribution of the workers some such arrangement is clearly necessary; and, further, the committee indicates the need, in its opinion, of keeping the workers in touch with the work done abroad.

The creation of scholarships is recommended, but a department of foreign inquiry, either by scholarship or commission, would enhance the knowledge of the whole body, and prove a constant stimulus to the highest effort.

A point of considerable importance is raised by the reference to laboratory facilities. "Access" to these by various local centres of work must always give way in effectiveness to work done by small equipments for diagnosis at these centres. The Commissioners consider that not merely tuberculosis, but any disease from which the assured may suffer may come under similar review.

On taking the figures from the 1909 census report, tuberculosis claims 10·5 per cent. of all causes of mortality, and that of the "respiratory" group following pneumonia and bronchitis—it will be noted that thus combined this figure exceeds the former. It must not be forgotten, however, that the latter includes cases of non-diagnosed tubercle, and others the essential feature of which is old age.

Tuberculosis, therefore, would claim the fullest, if not the sole, attention at first. This is confirmed by the figures just to hand of the results of the first year's working of the compulsory notification of infective diseases, including tubercle. Tuberculosis heads the list with 110,551 cases, which amount to 3·06 per 1000

population. The next return is scarlet fever, 2·98 per 1000. This takes no account of the difference in mortality or disability entailed by these two diseases, and if allowed for would greatly raise the former.

The committee is to be congratulated upon an earnest attempt to deal constructively with a complex question. Its tendency throughout to ignore the medical department of the Local Government Board will doubtless be rectified later in the interests of unified public health administration.

NOTES.

THE Secretary of State for the Colonies has appointed a Commission to study the nature and the relative frequency of the fevers occurring amongst the Europeans, natives, and others in West Africa, especially with regard to yellow fever and its minor manifestations. The members of the Commission are:—Sir James K. Fowler, K.C.V.O. (chairman), Major Sir Ronald Ross, K.C.B., F.R.S., Colonel Sir William Leishman, F.R.S., Prof. W. J. R. Simpson, C.M.G. Mr. A. Fiddian, of the Colonial Office, has been appointed secretary to the Commission, and Mr. T. F. G. Mayer assistant secretary. In the absence of special reasons, the members of the Commission will not themselves proceed to West Africa, but local investigators will work under their direction at certain centres. As at present arranged, those centres will be Freetown in Sierra Leone and Sekondi and Accra on the Gold Coast. The investigation will be set on foot towards the end of April or early in May. Endeavours have been made to enlist the cooperation of all medical men practising in the British dependencies in West Africa, whether as Government medical officers or otherwise. The funds for this investigation will be provided by the West African dependencies.

M. JULES DE PAYER has furnished the Paris correspondent of *The Pall Mall Gazette* with particulars of his projected arctic expedition, which is intended to leave France in the summer. With the support of the Government and various societies, he will follow his father, the distinguished explorer, in making for Franz Josef Land. One of his objects is to locate the margin of the polar basin to the north-east of that archipelago, an investigation which, if successfully carried out, will provide data for an estimate of the relative areas of the basin and the continental shelf in that quarter of the arctic region. A scientific staff will accompany M. de Payer, with equipment for the prosecution of research in all the various departments which have become associated with polar work; among them the investigation of the upper atmosphere by means of kites is specially indicated. The party will be provided for a sojourn of one year or longer in the north, its ship returning in the meantime. It is to be provided with two aëroplanes, the utility of which as instruments in polar research will be observed with interest: a visit to the pole itself is mentioned as a possibility, but does not appear as a prime object of the expedition. Wireless telegraphy will be installed at the headquarters.

ALL who had the pleasure of the acquaintance of Mr. Carl Hagenbeck—whose death occurred at Hamburg on April 15—could not fail to recognise the indomitable will and dogged perseverance of the man, coupled as they were with a manner of unusual gentleness and kindliness. It was no doubt owing to this unusual combination that Hagenbeck was so signally successful in his trade, for by the former traits he carried out in the most thorough manner every venture upon which he embarked, while by the latter he attracted and tamed his captives in a manner peculiarly his own. Born in a suburb of Hamburg in 1844, young Hagenbeck early acquired an interest in animals from his father, and eventually succeeded in securing the greater portion of the world's trade in wild beasts. In fact, if an animal was wanted you had but to tell Hagenbeck, and, unless war or other political obstacles barred the way, it was practically sure to come. But Hagenbeck's fame was largely based on his novel ideas with regard to the treatment of wild animals in confinement, more especially in the matter of an outdoor life for tropical species in Europe, and in the abolition of visible walls and bars, so that spectators might behold the captives in a state of comparative freedom. These ideas were embodied in the animal park at Stellingen. In 1899 Hagenbeck published, under the title "Von Tieren und Menschen," an account of his life and experiences, an abbreviated English translation of which appeared during the same year.

THE South Metropolitan Gas Company has appointed Mr. J. S. G. Thomas as research physicist to undertake investigations for technical purposes.

THE death is announced, at fifty-two years of age, of Prof. A. C. Elliott, professor of engineering at the University College of South Wales and Monmouthshire, and president of the Institution of Locomotive Engineers.

MR. A. R. HINKS, F.R.S., chief assistant at the Cambridge University Observatory, has been appointed Gresham professor of astronomy, London, in succession to the late Mr. S. A. Saunder.

PROF. L. J. Landouzy, dean of the Paris faculty of medicine, and known by his researches in connection with nervous diseases and tuberculosis, has been elected a member of the Paris Academy of Sciences, in succession to the late M. Teisserenc de Bort.

ON Thursday last, April 17, Mr. G. Hamel, accompanied by a passenger, accomplished a non-stop flight on a two-seater Blériot monoplane from Dover to Cologne, the direct distance being nearly 250 miles, in about four hours and a quarter.

AT the ordinary scientific meeting of the Chemical Society, held on Thursday, April 17, the president, Prof. W. H. Perkin, F.R.S., announced that an extra meeting will be held in the rooms of the society on Thursday, May 22, at 8.30 p.m., when a lecture in honour of the memory of the late Prof. Jacobus Henricus van't Hoff, honorary and foreign member, will be delivered by Prof. James Walker, F.R.S., of Edinburgh.

A FURTHER valuable gift has just been made to the Hull Municipal Museums Committee by Mr. C. Pickering, the donor of the new Museum of Fisheries and Shipping at the Pickering Park. It was recently represented to him that the new museum was already crowded with exhibits, and he has kindly presented a strip of land stretching from the Hessle Road to the Pickering Park, and adjoining the present museum, for the purpose of extension.

ON Tuesday next, April 29, Prof. W. Stirling will begin a course of three lectures at the Royal Institution on recent physiological inquiries. Owing to the illness of Prof. Bateson, his course of lectures on the heredity of sex and some cognate problems has been postponed. In addition to the Friday evening arrangements already announced, discourses will probably be given by Mr. F. Balfour Browne, Capt. C. G. Rawling, Prof. Silvanus P. Thompson, Mr. Owen Seaman, and Dr. Francis Ward.

UNDER its curator, Mr. A. G. Thacker, the Public Museum at Gloucester is being actively developed. The fine collection of Roman remains is being extended and rearranged. In the archæological department the museum has received from Sir W. T. Thiselton-Dyer a collection of the "river-drift" type of palæoliths. The Cotswold district abounds in Neolithic implements, which are here well represented. But in this latter department, by the gift of the fine collection made by the late Mr. G. B. Witts, the museum at Cheltenham holds, perhaps, a higher place. Between the two the Neolithic culture of the southern midlands is now admirably represented.

IN the transmission of pathogenic trypanosomes of man and domestic animals by tsetse-flies in Africa there has been some difference of opinion amongst investigators as regards the connection between the infectivity of the fly and the invasion of its salivary glands by the trypanosomes. Kleine was of opinion that the development of *Trypanosoma gambiense* in *Glossina palpalis* was limited to the intestine of the fly, while the Royal Society's commissioners in Uganda considered that the invasion of the salivary glands was necessary to render the fly infective. In a memoir published in *Annals of Tropical Medicine and Parasitology* (vol. vi., No. 4), Kinghorn, Yorke, and Lloyd publish a number of experiments on the transmission of *T. rhodesiense* by *G. morsitans*, which prove in the most convincing manner that the fly only becomes infective when its salivary glands are invaded and is non-infective when the trypanosomes are confined to the intestine only, even if swarming in this part. The trypanosomes found in the salivary gland resemble the stumpy form found in mammalian blood, and differ from the predominant type found in the intestine of the fly. The same result has been obtained by Miss Muriel Robertson in her researches on the development of *T. gambiense* in *G. palpalis* (Phil. Trans. (B), vol. cciii.).

THE fresh-water fishes of South Africa form the subject of an illustrated report by Messrs. Gilchrist and Wardlaw Thompson, published as part 5 of vol. xi. of the Annals of the South African Museum. It is based on collections in the South African, Bulawayo, and Transvaal Museums, a large proportion of which was procured by the aid of grants from the British and the South African Associations for the Advancement of Science. A considerable number of species are described as new.

ACCORDING to the report for the past year, the Rugby School Natural History Society continues its activity in all branches, the entomological section being particularly remarkable for its energy, as exemplified by a long list of the species of four orders of insects collected in the neighbourhood. We have also received the seventy-ninth report of the Bootham School Natural History, Literary, and Polytechnic Society, in which it is recorded that two of the members obtained prizes at a public-school essay competition arranged by the Royal Society for the Protection of Birds.

MR. G. FISCHER, Jena, has sent us a reprint from the "Handwörterbuch der Naturwissenschaften," entitled "Leitfaden der Descendenztheorie," by Prof. L. Plate, of Jena (price 1.60 marks). The author attempts in fifty-five pages, of which nearly half the space is occupied by illustrations, to sketch the outlines of the evidence on which the evolution theory is based. When the difficulties of compressing the subject to this extent are remembered, the result must be regarded as remarkably successful. All the chief lines of argument are mentioned, with the exception of those derived from the study of heredity and experimental morphology, which are dealt with in a separate section of the *Handwörterbuch*. The style is simple, and the cases chosen in illustration well suited to the purpose, but it is perhaps unfortunate that scarcely any examples are taken from the vegetable kingdom.

IN the report of the American Museum of Natural History for 1912 attention is directed to the policy of instituting exploring and collecting expeditions, rather than depending on purchase, as the chief means of increasing the collections. "While specimens for exhibition are the chief aim of the explorer, he brings back a large amount of information regarding the country visited, as well as photographs, drawings, or paintings, which are absolutely essential both for publication and as accessories to exhibition. . . . In all, thirty-five parties were operating in the field during the year 1912; every continent on the globe except Australia has been visited, and remarkable success has crowned the efforts of the leaders." Illustions of several of the new exhibits, including one of a fine pair of African forest-hogs, render the report highly attractive.

THE report of the Dove Marine Laboratory, Cullercoats, for the year ending June 30, 1912, deals with a considerable number of subjects bearing more or less directly on practical fishery questions. In most cases these are dealt with very briefly, and it might perhaps be suggested that conclusions of more permanent value would be reached if fewer subjects were investigated, and those that were attempted were more thoroughly and exhaustively done. The paper by B. Storrow on *Nephrops norvegicus* is the most

satisfactory from this point of view, and is based on a somewhat extensive collection of valuable data. The note on the spawning of the plaice by the same author, on the other hand, with its accompanying plate, seems to be of only trifling value, and might well have been allowed to rest in the laboratory notebook until further and more conclusive observations could be added. Prof. Meek contributes short papers on lobster culture, on mussel culture, and on the protection of crabs and lobsters, and measurements of certain samples of herrings are also recorded.

In the current number of *The Quarterly Journal of Microscopical Science* (vol. lviii., part 4) Mr. G. E. Johnson gives an account of those familiar yet little-known organisms, the nematodes of the common earthworm. Larval nematodes occur abundantly, both encysted in the body-cavity and in an active condition in the nephridia. These are shown to belong to the same species, which the author distinguishes as '*Rhabditis pellio*, Bütschli, non Schneider." As Schneider's species was described first it is obvious, as the author points out, that a new specific name will be required for the form under discussion, but he refrains from giving this name until Schneider's species shall have been re-examined. Apparently the nematodes do no harm to the earthworm, and they only reach the adult condition in the decaying body of the worm after the latter has died. There is no evidence of another host, but the complete life-history is not yet known. Another paper of interest from the point of view of economic zoology is by Mr. J. Davidson, being the first part of an elaborate memoir on the structure and biology of the woolly aphis of the apple-tree, often known as the American blight. Captain Meek contributes a useful discussion on the mechanism of mitosis, from which it appears very evident that, in spite of numerous theories, no satisfactory explanation of the phenomena has yet been arrived at. The only general conclusion that can be drawn at present appears to be "that the mitotic spindle is not a figure formed entirely by the action of forces at its poles."

The April number of *Bedrock* (vol. ii., No. 1) offers a varied and interesting bill of fare to its readers, ranging from a study of Japanese colonial methods, by Miss Ellen Churchill Semple, to Prof. H. H. Turner's essay on the nebular hypothesis and its developments. Miss Semple's article affords an interesting glimpse of the up-to-date application of scientific principles to colonisation as practised by the Japanese. In the island of Formosa the savage aborigines are isolated by means of a wire fence 300 miles long, the lowest wire of which is charged with an electric current strong enough to stun or kill anyone trying to climb over or creep under it. The fence is guarded at intervals of 500 yards by block-houses with armed police, one of whose functions is to receive the natives within the pale of civilisation when they are prepared to submit, and thenceforth to educate and look after them generally. Prof. Poulton contributes a very useful account of the latest advances in our knowledge of the phenomena of mimicry, as illustrated by the African Papilioninæ. It will be remembered that the polymorphic females of certain species of this group of butterflies are adapted to mimic various species of Danainæ and Acræinæ in different parts of the continent, and that one and the same female may produce several different forms of mimicking offspring. Prof. Poulton dismisses the suggestion that the different forms of mimicking pattern have arisen by sudden mutation, and brings forward evidence to show that they have been produced gradually by natural selection. At the same time he adduces evidence which suggests that the different patterns may be inherited in Mendelian fashion. The discussion on telepathy as a fact of experience is continued by Sir Oliver Lodge and Sir Ray Lankester, and Mr. McDougall has a very interesting article on modern materialism, in which he discusses the question of Vitalism *versus* Mechanism. Considerations of space prevent us from mentioning other valuable contributions.

Reprints have been received of two interesting papers dealing with the evolutionary aspects of plant ecology, one by Rev. G. Henslow ("Evolution considered as Bearing upon the Evolution of Plants," *Scientia*, vol. xiii., 1913, 19 pp.), and the other by Mr. L. Cockayne, F.R.S. ("Observations Concerning Evolution Derived from Ecological Studies in New Zealand," Trans. N.Z. Inst., vol. xliv., 1912, 50 pp., 8 plates). The latter is of especial importance from the wealth of observational data which it contains, throwing light upon various problems in the ecology and biology of plants in general, and suggesting many others which are open for investigation. It is not possible here to analyse these publications, which will doubtless receive attention in the newly founded *Journal of Ecology*. It must suffice to say that both authors urge that students of evolution have not paid sufficient attention to the material drawn from the ecological study of vegetation, and that many facts concerning the relation of plants to environment can only be adequately explained on the assumption that characters evoked by stimuli affecting the body-cells are emphatically capable of being inherited.

Lady Isabel Browne has sent a reprint of "Contributions to our Knowledge of the Anatomy of the Cone and Fertile Stem of Equisetum" (*Annals of Botany*, vol. xxvi.), from which it appears—as so frequently happens—that the re-investigation of the structure of even the most familiar plants, especially those belonging to groups which had a much greater development in the past than at the present day, results in the filling-up of various gaps in the knowledge of these groups. The author gives an historical introduction indicating previous work done on this much-investigated genus, and after presenting the results of her own thorough examination of the anatomy of the cone and fertile stem of several horsetail species, discusses the general organisation of the cones in the recent and extinct Equisetales. The structure of the cone axis or stem supports the view that the spore-bearing organs (sporangiophores) are whole appendages and not lobes of a sporophyll or leaf. The collar-like outgrowth (annulus) below the cone in recent horsetails appears to represent a reduced node;

this is confirmed by the anatomy of abnormal specimens of the field horsetail in which more than one annulus is present.

THE report of experiments carried out in 1912 at the Harper Adams Agricultural College and in Shropshire and Staffordshire contains accounts of inquiries into the effect of pruning and of grass on fruit trees, the wart disease of potatoes, the manuring of grass land for milk, &c. During the past year oats in many parts of the country were badly attacked by the frit-fly (*Oscinis frit*), and since the life-history of this pest is not fully known, investigations in this direction have been instituted. Although preventive measures cannot be given at present, it may be noted that early sown crops are not so liable to attack as those sown later, and also that a dressing of nitrate of soda helps the plant to recover from initial attack by the pest. How far the severity of attack depends on the variety of oat has still to be ascertained, but striking differences were observed among the varieties cultivated last year.

MESSRS. E. S. SALMON and C. W. B. WRIGHT contribute a paper to the March number of the Journal of the Board of Agriculture on lime-sulphur wash for American gooseberry mildew. As a result of extended observations it has been found that different varieties of gooseberries differ to a marked degree as regards the susceptibility of the foliage to injury from the wash. It is possible with some varieties, *e.g.* "May Duke," to spray repeatedly throughout the season with lime-sulphur, at a strength (1·01 sp. gr.) sufficient to prevent the attacks of the mildew, without causing any injury to the foliage. In other cases it seems probable that the foliage of a variety may be resistant to injury from the wash, while showing susceptibility later in the season. Other varieties, such as "Valentine's Seedling" and "Yellow Rough," are so sensitive that they cannot safely be sprayed with lime-sulphur.

THE report of Stonyhurst College Observatory (Lancashire) for 1912 contains results of meteorological, magnetical, and seismological observations, together with mean and extreme values for the last sixty-five years. Some of the meteorological results for last year are noteworthy from several points of view. The annual rainfall was $7\frac{1}{4}$ in. above the average; in March the amount was more than double the average, and was the greatest on record for that month. The duration of bright sunshine was nearly 410 hours below the yearly average (thirty-two years); August had only 50 per cent. of the normal amount, and the maximum temperature was 11·6° below its average highest reading. Father Sidgreaves states that owing to the decision of the Meteorological Office to reduce the number of its observing stations the connection of Stonyhurst with the office would cease at the end of March, but we are glad to learn that the automatic recorders are to remain there, and will be kept in active service. This observatory is one of those adopted by the first Meteorological Committee (1867) for the continuous registration of meteorological phenomena at important positions in the British Islands. In the report of the Meteorological Committee for the year ended March 31, 1912, it was explained that the urgency of questions connected with the upper air had decided it to withdraw in some cases the grants made for the continuance of observations in the old form.

PART 5 of the first volume of the science reports of the Tohoku Imperial University, Japan, contains a paper on the magnetic susceptibilities of iron, steel, nickel, and cobalt up to temperatures of 1300° C., by Profs. Honda and Takagi. The method used depends on the measurement of the force under which the magnetisable material moves from a weak to a strong part of the magnetic field in which it is placed. The field was provided by a small du Bois electromagnet, and the force was measured by means of a delicate spring balance. The materials tested were placed in a small magnesia capsule surrounded by an electric furnace. The temperature of the specimen was determined by means of a platinum platinum-rhodium thermo-junction standardised by the use of the melting points of lead, zinc, antimony, copper, and nickel. As the result of their investigations, the authors find that Curie's law, according to which the susceptibility should vary inversely as the absolute temperature, does not hold for nickel below 500° C., does not hold over any extended range of temperature for cobalt, and is not even approximately true of iron or steel in what is known as the γ state above 800° or 900° C.

MESSRS. TOWNSON AND MERCER, LTD., have sent us a specimen of a new type of inorganic filter for laboratory purposes. The filter is cone-shaped, and is understood to be composed of powdered alundum (a variety of fused alumina) cemented by firing with siliceous material. It is sufficiently porous to allow of rapid filtration, is not sensibly affected by solutions of common chemical reagents, and withstands the usual temperatures employed in the laboratory. For use, it is fitted into an ordinary glass funnel by means of rubber tubing, and connected with a filter-pump. Paper filters can be employed with it, or not, according to requirements. One of the chief advantages is that the filter can be used for quantitative determinations in the same manner as a Gooch type of filter, but without the trouble of preparing an asbestos layer every time. A light aluminium stand is supplied for convenience in weighing. How far any difficulty of cleansing or liability to fracture might prove troublesome, only extended trial could show; but a few summary experiments indicate that the filters will probably be very convenient for many gravimetric chemical operations. The makers are the Norton Company, Massachusetts.

IN the course of an article on the relation of engineering and architecture, *The Builder* for April 11 suggests two main considerations as accounting for the division which now exists: one, the public willingness to accept great works of engineering as necessary evils from an æsthetic point of view; the other, the greater extent to which the engineer must be immersed in the practical considerations of high mathematical problems which have to be solved in connection with many engineering works. The latter, it is asserted, tends to the narrowing of the mental point of view. The remedies suggested are the education of public opinion so that it will demand the æsthetic treatment of engineering work, and the

unification of engineering and architecture as component parts of one calling. Our contemporary considers that the engineer should have a preliminary training in architecture, and that the architect would be the better artist if he had studied something of the principles which underlie engineering, instead of going through the world content to hoe his own furrow irrespective of the general field.

Engineering for April 18 contains a very full illustrated description of the new Cunard liner *Aquitania*, which is being built and engined by Messrs. John Brown and Co., Ltd., of Clydebank. This vessel is the largest ship yet built for the express service to New York. The following are the principal dimensions:—Length over all, 902 ft.; breadth, 97 ft.; depth, 64 ft.; displacement, 49,400 tons; shaft-horse-power of the four-screw steam turbines, 60,000; 4230 passengers and crew are provided for. There are forty-one watertight compartments in the double bottom, and eighty-four watertight compartments in the moulded structure of the ship above the double bottom, formed by transverse and longitudinal bulkheads and watertight decks. The transverse bulkheads have been carried up to an unusual height. The conditions are such that should the fore part of the ship for the first five compartments, or the after part of the ship for the six after compartments, or the five centre compartments, be open to the sea, the ship would still remain in a perfectly stable condition. To render possible the launching and navigation of the vessel to the sea, it has been necessary to widen and deepen the channel of the River Clyde, a work which will be of lasting benefit to navigation. The ship was launched successfully on Monday last.

IN the announcement of Canadian tide tables made in NATURE of March 27 (p. 95), it was implied that they are issued by the Government Printing Bureau at Ottawa, whereas, Mr. W. Bell Dawson writes to point out, they are merely printed there, and are prepared and issued under his direction from the office of the Tidal and Current Survey, Ottawa. It may here be mentioned that the Tide Tables are issued in two series, which refer to eastern Canada and the Pacific respectively, the tides of two oceans 3000 miles apart, on opposite coasts. The work of the Canadian Survey is thus very extended, and the limited staff which carries it on is beginning further investigation in Hudson Bay, an area much larger than the North Sea, and quite as complex in its tides.

OUR ASTRONOMICAL COLUMN.

THE SOLAR UNION AT BONN.—The fifth meeting of the International Union for Cooperation in Solar Research will be held in the Physical Institute of the Bonn University on July 31 next, and a preliminary programme for that occasion has now been circulated. On the evening of July 30 a reception will be held in the large hall of the reading and recreation society, and the mornings of July 31, August 1 and 2, and afternoons of the two former dates, will be devoted to the discussions. The afternoon and evening of August 2 and the whole day of August 3 will be taken up with a visit to Cologne, a reception being given in the hall of the Gürzenich at the invitation of the city of Cologne, and probable alternative excursions to (1) motor through the Eifel to the valley of the Mosel, and (2) tour in the Siebengebirge. August 4 and 5 will see the resumption of the meetings, and the afternoon of the latter date may be employed in a steamer trip on the Rhine. In addition to the above, Prof. Küstner will receive the members at the observatory on the afternoon or evening of August 1, Prof. Karl Hausmann invites them to visit the Technical High School at Aachen, and the Astrophysical Observatory at Potsdam invites members for August 11.

A CASE OF LARGE PARALLEL PROPER MOTION.—Dr. Ragnar Furuhjelm, of the Helsingfors Observatory, communicates to the *Astronomische Nachrichten* (No. 4642, p. 179) an instance he has found of two stars fairly wide apart having the same velocity and direction of proper motion. The stars in question are a double star, BD+45° 4408 and No. 12740 in Burnham's catalogue (8·3 m. and 8·3 m., α=oh. om. 23s., $\delta=+45°\ 15·5'$, 1900·0), the proper motion of which was earlier known and measured, and a star of the magnitude 9·5 m., its distance from the above binary being about 5·5 minutes of arc. Dr. Furuhjelm gives in detail the measures he made of both these stars on several plates which he had taken at different times in that region, and deduces the value of 0·9″ for the proper motion of the system, and 327·58″ and 254° 13·7′ for the distance and position angle of stars. Finally, he directs attention to another similar case of large parallel proper motion as is exhibited in the stars A Ophiuchi and 30 Scorpii, which are about 12·2′ apart, and undergo a proper motion of 1·25″. In this instance also one of the stars is a double with a distance of 4·2″. Such systems form important objects for study.

THE SOLAR ROTATION IN 1911.—In the March number of *The Astrophysical Journal* (vol. xxxvii., No. 2) Messrs. J. S. Plaskett and Ralph E. DeLury describe and give the results of their very thorough investigation relating to the spectroscopic determination of the solar rotation. The work was carried out at the Dominion Observatory at Ottawa, the observatory having undertaken this programme of work on the lines determined by the International Union for Cooperation in Solar Research. The instrumental equipment at the Ottawa Observatory is of first-rate quality, and is all that is needful for the research which has been so successfully brought to an issue. The communication in question is of considerable length, and the authors describe and discuss the difficulties met with as regards personalities in measurement, instrumental errors, &c. The chief conclusions to which they ultimately reached were that the values they deduced for the solar rotation could be represented by formulæ which were in exceedingly good agreement with those obtained by Dunér and Adams (1908), except for a small and nearly constant angular difference. The absolute velocity of the solar rotation seems to be uncertain by a small amount, amounting to 2 or 3 per cent., due, as they suggest, to personal differences in the habit of measurement of the rotational displacements on the plates. No systematic differences of velocity were found for different elements, although they discussed 3000 residuals from different lines and elements. It is of interest to give here the different formulæ for the rotation as deduced by the authors and previous investigators:—

	Angular velocity.
Dunér	$10·60° + 4·21° \cos^2 \phi$
Halm	$12·03° + 2·50° \cos^2 \phi$
Adams (1908)	$10·57° + 4·04° \cos^2 \phi$
Adams (mean)	$11·04° + 3·50° \cos^2 \phi$
Plaskett (1911) ...	$10·32° + 4·05° \cos^2 \phi$
DeLury (1911)	$10·04° + 4·00° \cos^2 \phi$

THE TENTH INTERNATIONAL GEOGRAPHICAL CONGRESS AT ROME.

THE report of progress and the discussion regarding the international map of the world and polar exploration were the two predominant subjects at the International Geographical Congress just concluded at Rome. The long postponement from October, 1911, to April, 1913, was sufficient to account for the meagre attendance of British representatives, of whom there were only ten, and indeed foreign members as a whole. Polar exploration—both arctic and antarctic—was, however, well represented. Of the former, Admiral Peary, Admiral Cagni, Dr. Bruce, Mr. Bridgeman, and Mr. Stefánsson were representative, whilst Dr. Bruce, Dr. Nordenskjold, and Lieut. Lecointe represented antarctic exploration. There were also many others specially interested in polar research, as was testified by the presence of thirty delegates at the Polar Commission, which took the opportunity of meeting at the same time and place as the Geographical Congress. Although no striking results have accrued from this rather anomalous body, yet it gives an excellent opportunity for polar explorers and their supporters to meet and discuss matters of common interest, and, being in strong force, special interest was naturally shown in their work, and several important communications given.

International Map.

The most important result of the congress was the discussion and agreements reached regarding the international map of the world on a scale of 1 : 1,000,000. The British representatives who took special part in this section were Col. C. F. Close, Director-General of the Ordnance Survey of Great Britain; Col. W. C. Headley, Mr. F. Grant Ogilvie, C.B., and Mr. G. G. Chisholm. General Jules de Shokalsky, St. Petersburg; Prof. Albrecht Penck, Berlin; Engineer Charles Lallemand, and Prof. Paul Helbronner, Paris; Lieut. A. H. Byström, Stockholm; Dr. H. von Hartenthurn, Vienna, also took part in the discussion. Nine States had undertaken the production of sheets of the international map in accordance with the resolutions of the official conference held in London in November, 1909, namely Argentina, Chile, France, Great Britain, Hungary, Italy, Japan, Spain, and the United States, and preparation work was also reported by the delegates of Portugal and Sweden, and the thanks of the congress were voted to those States.

By direction of the president of the congress in accordance with the resolution proposed by Prof. Penck, and approved at the general meeting of the congress, March 29, delegates of all countries interested in the international map held a meeting on March 31, 1913, and passed the following resolutions unanimously, and the resolutions were submitted to the congress:—

(1) It is desirable that another official conference should be held to consider questions affecting the international map of the world on the scale of 1 : 1,000,000, in the capital of a State which has already undertaken the preparation of sheets of the map; and it is thought that it would be convenient to all concerned if this capital were Paris.

(2) In view of the fact that the general principles governing the construction of the map are already settled and adopted, the new conference should be asked to consider questions of detail only, such as the size of the lettering, character for railways, &c.

(3) It is desirable that all civilised States should be invited to send delegates to the proposed conference.

(4) It would be convenient if the date of the proposed conference were towards the end of the year.

(5) London (Geographical Section of the General Staff, War Office) remains the official centre of the undertaking until the assembly of the proposed conference, and communications of interest with regard to the international map should be addressed to that office. Also, it is desirable that a set of not fewer than fifty copies of a selected sheet already printed should be sent by each country which has produced a sheet or sheets to the above office, at an early date. These sheets will be distributed to those Governments invited to the new conference, and to recognised private authorities.

Polar Exploration.

In arctic exploration special interest was also shown in Mr. Vilhjálmur Stefánsson's plans of the Canadian Arctic expedition, which leaves Vancouver about June 1 for a period of three and a half years. As a preliminary to laying these plans before the congress, Mr. Stefánsson gave a detailed account in two sections of his six years' work on the Mackenzie River and along the arctic shores of Canada and on the islands to the north. During practically the whole of that time he lived as an Esquimaux among Esquimaux, learning their language and many of their customs, and making himself dependent on the resources of the country. By this account of his previous work he showed that no one was better fitted to carry out the plans of the new Canadian Arctic expedition, which he himself had formulated. It was of special interest to hear Mr. Stefánsson emphasising not only the importance, but the great accuracy of the work of the late Dr. John Rae.

Mr. Stefánsson's plan generally is to explore the Beaufort Sea and to seek for new lands to the north-west of those known islands lying to the north of the mainland of Canada, and to carry on further research, especially as regards his discovery of Esquimaux of a blonde type living to the north-west of Victoria Land. Special interest attaches to the expedition, because the theory which Mr. Stefánsson and others have is that the tides indicate a considerable area of land lying in the Beaufort Sea to the north-west of Victoria Land.

Admiral Peary, in supporting the plans, pointed out that the American Geographic Society and the American Museum of Natural History had in the first place come forward, each offering to pay half, but that subsequently the Government of Canada had desired to make the expedition a Canadian one, seeing that it was for the exploration of Canadian arctic regions, and had offered to pay the whole cost. They in the United States appreciated the attitude of Canada. They had followed Mr. Stefánsson's past and present work with the greatest interest, and wished his expedition the success it deserved. Dr. Bruce, in supporting the proposal, pointed out how, whereas the Pacific side of the south polar regions had received most attention from explorers, it had been on the Atlantic side that the north polar regions had been chiefly explored. This was due, he said, to the fact that the Atlantic side of the arctic regions was nearer the centres of civilisation. The regions Mr. Stefánsson intended to explore was particularly interesting from the oceanographical point of view, because no oceanographical research had been carried out on the Behring Straits side of the Arctic Ocean. Mr. Stefánsson was taking with him a considerable oceanographical equipment and an excellent oceanographer, in the person of Mr. James Murray, who had done signal service with Sir John Murray in the Scottish Loch Survey, and with Sir Ernest Shackle-

ton in the antarctic regions. He thought the action of the Canadian Government was to be applauded, and served as an example to other Governments on this side of the Atlantic.

Mr. Bridgeman gave a note on the Crocker Land expedition, as well as an interesting eulogy on Admiral Peary, entitled "Peary: the Man and His Work." Mr. Bridgeman showed a most beautiful series of slides of arctic scenery. Among other arctic papers was one by Dr. O. J. Skattum, of Christiania, on the map of Spitsbergen. Excellent as is the recent work of the Norwegians in Spitsbergen, he made a serious omission by making no reference to the highly detailed geodetic work in Prince Charles Foreland that has been done by Dr. W. S. Bruce and Mr. John Mathieson in 1906, 1907, and 1909. Neither did he acknowledge the financial and other help given to the Norwegians by the Prince of Monaco, who has also helped the Scottish expeditions. Dr. Skattum should spell "Spitsbergen" with a central "s" and not "z." the word being of Dutch and not German origin.

An arctic paper of great interest and importance was given by General de Shokalsky, who also made several other important communications. It was on the work carried out by the officers of the Russian Navy and the Russian Geographical Society during the last twelve years. This work includes much detailed and valuable geographical research, on strictly scientific lines, that has been done along the arctic shores of Russia and Siberia, and seas adjacent. His paper on the new hypsometrical map of the Government of Moscow on a scale of 1 : 168,000 might also be regarded as an important contribution to arctic geographical research.

Antarctic Research.

Dr. W. S. Bruce gave an account of his plans for another Scottish Antarctic expedition, which have already been given in detail at a meeting of the Royal Scottish Geographical Society, and for which the treasurer of the society is receiving subscriptions amounting already to a considerable but, as yet, by no means adequate amount. The plans, it will be remembered, are to carry out further extensive oceanographical research in the region of the Weddell Sea, to explore the continent in the neighbourhood of Coats Land, and to complete a sectional survey of Antarctica, by a journey across from the Atlantic to the Pacific side of the continent. The plans were very strongly supported by Admiral Peary, who urged the special importance of a journey to the south pole on the Weddell Sea side of Antarctica, and the importance of detailed oceanographical research. He agreed with Dr. Bruce that there was plenty of room for many nations to work together in the antarctic region, and hoped that the United States would take part in the south polar campaign. Mr. G. G. Chisholm, secretary of the Royal Scottish Geographical Society, said that the plans had the hearty support of that society. The plans were also cordially supported by Prof. Penck, of Berlin, who referred to the work of Lieut. Filchner and his important discovery of an extension of Coats Land to the south-west. Dr. Otto Nordenskjold's was the other antarctic contribution, namely, "A Comparison of the Inland Ice of Arctic and Antarctic Lands," an important contribution to glaciology.

Dr. Gerhard Schott, of Hamburg, gave an account of recent German oceanographical research in the Atlantic Ocean, and Prof. Drechsel, of Copenhagen, dwelt on the importance of continuous and periodic hydrographic researches carried on at definite stations, such as has been carried out recently by the Prince of Monaco and Dr. Richard in the Mediterranean. Prof. J. Thoulet, of Nancy, dwelt on the construction an utility of bathy-lithogical submarine charts, a pape that was in many respects very suggestive. Mis Owens's account of the geysers of Yellowstone Par was an important contribution.

On the whole the papers were of good quality, an showed the result of steady geographical researc during the past four and a half years. But there i little doubt that the congress was seriously affecte by the postponement on account of the Turco-Italia war, many who had offered contributions withdrawin them and presenting them to various geographica societies in the meantime.

It was resolved to hold the next congress at St Petersburg on the invitation of the Russian Govern ment, presented to the congress by General d Shokalsky.

A rather heated discussion arose on the questior of introducing Spanish as an official language, but this proposal was withdrawn, a special veto being given to the proposal by General de Shokalsky threatening to introduce Russian as an official language if the proposal were insisted on.

INTERNATIONAL METEOROLOGY.

A MEETING of the International Meteorological Committee was held in Rome on April 7–12, at the invitation of Prof. Palazzo, director of the Italian Meteorological Service. The meeting was attended by Dr. W. N. Shaw, president of the committee, Geheimrat Hellmann, the director of the Prussian Meteorological Service, secretary, and the following members, representing the meteorological services of their respective countries:—*France,* M. Angot; *Portugal and Azores,* M. Chaves; *Holland,* M. van Everdingen; *Sweden,* M. Hamberg; *Switzerland,* M. Maurer; *Italy,* M. Palazzo; *Denmark,* M. Ryder; *Russia,* M. Rykatcheff; and *Canada,* Mr. Stupart. There were also present Prof. Hergesell, the president of the International Commission for Scientific Aëronautics, and Prof. Bjerknes, who had made important proposals, at the meeting of this commission held in Vienna in 1912, regarding the form in which meteorological data for the upper air should be published. At the opening meeting letters expressing regret at their inability to attend the meeting were read from Prof. Mohn, *Norway*; Prof. Willis Moore, *United States of America*; Prof. Nakamura, *Japan*; and Dr. G. T. Walker, *India*.

It is the function of the International Committee to deal with questions of organisation in which international cooperation is required. A considerable number of such questions has become ripe for consideration by the committee in the three years which have elapsed since the last meeting, held in Berlin in 1910.

After the conclusion of the formal inaugural business the first meeting was devoted to the consideration of a letter which had been received from the president of the International Institute of Agriculture, asking for the assistance of the committee in furthering questions connected with the influence of the weather in agricultural affairs. Apart from questions connected with weather forecasting, there are many problems connected with the influence of weather on the yield or quality of crops or the suitability of particular climates for particular crops which are capable of advancement by statistical methods, but as yet little progress has been made in this direction. The committee finally appointed a permanent commission to undertake the further working out of these questions. M. Angot was asked to act as president of this commission, and MM. Börnstein, Brounow, Louis Dop, Hergesell,

Palazzo, and Stupart as members, it being understood that the commission would coopt additional members.

The second day's sitting was devoted to the consideration of the report of the Commission on Weather Telegraphy, which had held a meeting in London in September last, and of the comments which had been received from the various institutes concerned on the proposals of the commission. Apart from a few minor modifications, the committee approved the recommendations of the commission, which have been already referred to in a previous number of NATURE (vol. xc., p. 107). The institutes are invited to introduce the suggested modifications in the present arrangements for exchange of telegraphic meteorological reports within the European system on May 1, 1914. From that date onwards a uniform telegraphic code will be adopted throughout Europe, though the differences between the units adopted in this country and on the Continent will persist. Arising out of the report of the commission was the question of the receipt of information from ships at sea by wireless telegraphy. Up to the present this country stands alone in having a system for obtaining wireless reports from liners. Our geographical position invests such reports with special importance to us. It is now hoped that the regulations connected with weather radio-telegrams adopted at the International Radiotelegraphic Conference, held in London in the summer of last year, will result in a considerable curtailing of the time which these messages occupy in transmission. Should this anticipation be realised, it is probable that other countries would also desire to avail themselves of this means for securing information from the Atlantic Ocean, and the president was therefore requested to make inquiries regarding the matter.

At this meeting the committee also considered a report on the velocity equivalents of the numbers of the Beaufort scale of wind force in use in different countries drawn up by Messrs. Palazzo, Köppen, and Lempfert, by request of the Commission on Weather Telegraphy. The report showed that the equivalents used in different countries differ considerably, but they all have one feature in common, viz., that they are based on comparisons of estimates of wind force with hourly means of wind velocity as measured on Robinson cup anemometers. The last few years have witnessed a considerable advance in our knowledge of wind structure in consequence of demands which have been put forward by aviators, and thus the question arises whether the velocity in gusts should not find a place in any specification of the velocity equivalents of the Beaufort numbers that may be recommended for general international use. For this and other reasons the committee considered it inexpedient at the present juncture to recommend a definite scale of equivalents for general use, and contented itself with suggesting that if any meteorological service wishes to make a change in the hourly equivalents which are now in use, the new values should be so selected that they do not fall outside the limits set by the scales adopted in Germany and in this country. The gentlemen referred to above were requested to prepare a further report, on which the committee might base a more definite recommendation on some future occasion.

At the next meeting questions arising out of the investigation of the upper air were considered. M. Hergesell gave an account of the past work and future plans of the commission of which he is president. In connection with future plans, he stated that upper-air investigation would form an important part of the scientific work proposed by Capt. Amundsen in his projected drift across the polar basin in 1915, and it thus was very desirable to organise other observations in polar latitudes simultaneously with Capt. Amundsen's expedition. In connection with this subject, M. Rykatcheff stated that Russia contemplated carrying out soundings of the upper air at Jakoutsk and Verkhoyansk, and that there was also some prospect of expeditions being sent to Nova Zemlya and to the mouth of the Lena at the time of Amundsen's expedition, if other countries were prepared to cooperate in other parts of the polar basin. Inquiries elicited the fact that prospects seemed favourable for such cooperation. Thus M. Hergesell hoped to be able to arrange for the German station on Spitsbergen to remain in operation, and Mr. Stupart thought that he might be able to arrange for some work of the kind contemplated by the Stefánsson expedition which the Canadian Government is sending out. The committee warmly supported the proposal, and appointed MM. Hergesell, Rykatcheff, Ryder, and Stupart a small subcommittee to deal with the question.

A second question of importance arising out of the upper-air work concerned the units to be adopted in the international publication in which the results of ascents made in all parts of the world are collected. A proposal brought forward by Prof. Bjerknes had led the commission responsible for this work to adopt at its meeting in Vienna in 1912 a resolution recommending that pressure values should be given in absolute units, millibars, instead of in millimetres of mercury, with the proviso, however, that the recommendation should only become effective when it received the approval of the International Meteorological Committee. The proposal has given rise to acute controversy in meteorological periodicals during the past year. Absolute pressure units are in many ways particularly suited to upper-air measurements, and no one would oppose their use if it were possible to start afresh without reference to the material which has been already collected and published in other units. Actually opinion has been sharply divided between those who trust that the temporary inconveniences associated with all changes will soon be outweighed by the advantages accruing from the new system, and those who deprecate any departure from established practice. After considerable discussion, the committee met the difficulty by requesting the commission to print pressure values in absolute units, millibars, as well as in millimetres of mercury. The committee further recommended that this practice should be adopted in all publications giving the results of observations in the free atmosphere. Thus a very difficult question has been settled for the present at the expense of a slight increase in the number of figures to be printed. A further proposal, originating with Prof. Bjerknes, to give heights in "dynamic meters," or rather to give geopotential instead of height in units of length, was referred back to the commission for further consideration, at M. Hergesell's request.

At the following meeting the report of M. Maurer, the president of the Radiation Commission, was received. A letter from Mr. Hunt, the meteorologist of the Commonwealth of Australia, directed the attention of the committee to the Campbell-Stokes sunshine recorder. Instruments of this type are widely used for recording the duration of bright sunshine, and their indications are generally regarded as reasonably comparable *inter se*. It appears, however, that the British Meteorological Service alone has adopted a definite specification for the instrument, but there is no similar provision in other countries. The Radiation Commission was therefore requested to take into consideration the question of instituting comparisons between instruments of different form.

At the last meeting the report of the Commission on Maritime Meteorology and Storm Warning Signals was considered. The recommendations of the commission regarding day and night signals, drawn up at the meeting held in London in September, 1912, were adopted except for a few points, such as the night signal for a hurricane, which was found to be likely to be confused with other signals already in use. These recommendations have already been described in NATURE (*loc. cit.*). A substantial measure of international agreement in the matter of day and night storm warning signals has thus been attained.

The Rome meeting of the committee was the third which has been held since the Conference of the Directors of Meteorological Observatories and Institutes which met at Innsbruck in 1905. In accordance with established practice another conference of directors should be held before the committee can hold another meeting, and it was agreed to call together such a conference for the year 1915. Holland was suggested as a suitable country for the meeting.

M. Palazzo had been at great pains to entertain his visitors and to afford them opportunities of seeing the géodynamical and meteorological observatories near Rome. On the Tuesday the committee was entertained at a dinner, at which the Chief Inspector of Mines presided on behalf of the Minister of Agriculture, who sent a message regretting his inability to be present in person. On Wednesday the members were received at the International Institute of Agriculture by its president, the Marquis de Cappelli. The whole of Thursday was devoted to an excursion which had for its object the seismological observatory at Rocca di Papa, with which was combined a visit to the Lake of Albano and to Frascati. On Friday afternoon the committee was invited to a meeting of the Physical Society at Rome, where it was welcomed by the president, Prof. Blascona, and subsequently listened to a lecture by Prof. Bjerknes on the fields of force.

On Saturday afternoon, April 12, the military observatory at Bracciano was visited by motor. This observatory has been recently established, and many of the instruments were not yet finally installed. It is fully equipped, not only for ordinary meteorological work, but also for taking aërial soundings with kites, registering or pilot balloons. A pilot balloon ascent was carried out in the presence of the visitors, who were subsequently entertained by the commandant and his officers.

NICKEL STEELS IN CLOCK CONSTRUCTION.

IN a pamphlet on "Les Aciers au Nickel et leurs Applications à l'Horologerie" (Paris, Gauthier-Villars), M. Ch-Ed. Guillaume gives in a simple form an account of the properties of nickel steels and of their application to the construction of compensated clocks, chronometers, torsion clocks, and even watches. The well-known peculiarities of the nickel steels as regards dilatation and variation of elastic modulus and other properties with temperature are briefly described and explained on the ground that the presence of nickel depresses the temperature of the allotropic modification which occurs in iron at 890° C., and at the same time changes the transformation point of iron into a wide range of transformation temperature in the alloys. It is when they are within this widened transformation range that these steels possess abnormally low coefficients of expansion, &c.

M. Guillaume's exposition of the applications of these steels shows, however, that although the alloy-steel known as "invar" can be produced so as to have negligibly low expansion, that is not the result to be desired for horological purposes. In the case of clock pendulums having an invar rod, with bob and suspension of other metal, the compensation principle of Graham, used in the mercury pendulum, is employed, but the use of a nickel steel of low expansion avoids the use of a liquid and makes the attainment of compensation both simpler and more perfect in its results. A steel of zero expansion would be less convenient.

More striking still is the application of nickel steel of a desired (low) coefficient of expansion to the balance-wheels of chronometers of high accuracy. Here the use of these special steels has made it possible to eliminate the second-order errors arising from the fact that compensation effected for two definite temperatures did not, with the older materials, avoid serious errors at intermediate temperatures, owing to the fact that the expansion curves of the two compensating metals only crossed at two points and lay widely apart at intermediate temperatures.

The elimination of this secondary error has made it worth while to seek other improvements in chronometer construction, so that an almost revolutionary improvement in these instruments has been brought about. For watches in which a compensated balance-wheel is excluded on account of cost, the use of a hair-spring of a special nickel steel, to which some chromium has been added in order to raise the naturally low elastic limit, has resulted in the evolution of a cheap method of producing compensated watches. In this case the abnormal manner in which the elastic modulus of these steels varies with temperature has been utilised.

The similar anomalous variation of the torsion modulus has also been utilised in connection with the construction of clocks with torsion pendulums, and has brought these clocks into the range of reasonably accurate instruments for the measurement of time. They have the advantage of requiring very little driving power, and can therefore run for four hundred days on a single winding.

M. Guillaume points out that these important developments must all be regarded as resulting from the study of the internal transformations of solutions and of alloys and that they have resulted indirectly from the study of nickel steels for purposes of metrology. The gradual and also the transient changes of dimension to which steels of the "invar" type are known to be subject are fortunately too minute to interfere with these applications, provided the steel has been properly aged.

W. ROSENHAIN.

VARIATIONS OF THE SPECTRUM OF TITANIUM IN THE ELECTRIC FURNACE.

ENHANCED lines are taking a more and more prominent part in the discussion of both terrestrial and celestial spectra, and another valuable contribution to the subject comes from the researches of Mr. A. S. King, of the Mount Wilson Solar Observatory (*Astrophysical Journal*, vol. xxxvii., No. 2, March). The investigation which he has in hand deals with variations in the spectrum of titanium by different temperatures of the electric furnace in order, if possible, to fix the place of the enhanced lines on the temperature scale. As enhanced lines are in general difficult to produce in the furnace, he made the attempt of forcing the furnace temperatures up in order to make them appear in the spectra. This he has very successfully accomplished, and in the process he has been able to observe several re-

markable phenomena bearing directly on the nature of enhanced lines in general, which he describes in the present communication. Using larger dispersion than in his former experiments, and employing thinner tubes in the furnace, he ran the furnace until the tube wore thin with the strong vaporisation of the carbon, and ultimately broke. It was near this breaking period that the important observations were made.

The description of the experiments is given very fully in the paper, and is finely illustrated with reproductions of some of the spectra obtained, but here only the leading features of the research can be stated. The titanium enhanced lines appear in the regular furnace spectrum for temperatures probably somewhat higher than 2000° C., but are very faint compared with the arc lines. At still higher temperatures, the furnace conditions still existing, there is any indication of a slight increase in the relative strength of the enhanced lines. At the stage when the furnace tube burns through, resulting in the formation of a low-voltage arc, the consumption of electrical energy at the point being very large, the enhanced lines of titanium and the spark line λ4267 of carbon appear with an intensity usually attainable only in powerful sparks. Photographs taken with the slit across the entire image of the tube's interior show that the relative strength of the enhanced lines is much greater in the centre of the tube than near the wall, the effect being very pronounced in the case of the carbon spark line. Mr. King also directs attention to the important observation that the vapour in the centre of the broken tube shows a tendency to give a line farther to the red than near the wall, this being shown in the increasing dissymmetry of the lines from the end towards the middle. This effect, he points out, is in harmony with the action of the condensed spark, but can scarcely, in the case of the furnace lines, be ascribed to pressure.

ARISTOTLE AS A NATURALIST.[1]

AMONG the isles of Greece there is a certain island, *insula nobilis et amoena,* which Aristotle knew well. It lies on the Asian side, between the Troad and the Ionian coast, and far into its bosom, by the little town of Pyrrha, runs a broad and sheltered lagoon. It is the island of Lesbos. Here Aristotle came and spent two years of his life, in middle age, bringing his princess-bride from the petty court of a little neighbouring State where he had already spent three years. It was just before he went to Macedon to teach Alexander; it was ten years later that he went back to Athens to begin teaching in the Lyceum. Now in the "Natural History," references to places in Greece proper are very few indeed; there is much more frequent mention of places on the northern and eastern coasts of the Ægean, from Aristotle's own homeland down to the Carian coast; and to places in and round that island of Lesbos or Mytilene, a whole cluster of Aristotle's statements and descriptions refer. Here, for instance, Aristotle mentions a peculiarity of the deer on a neighbouring islet, of the weasels by the wayside by another island town. He speaks of the big purple Murex shells at Cape Lectum, and of the different sorts of sponges found on the landward and the seaward side of Cape Malia. But it is to the lagoon at Pyrrha that Aristotle oftenest alludes. Here were starfish, in such abundance as to be a pest to the fishermen; here the scallops had been exterminated by a period of drought, and by the continual working of the fishermen's dredge; here the sea-urchins come into season in the winter time, an unusual circumstance. Here among the cuttlefishes was found no octopus, either of the common or of the musky kind; here was no parrot-wrasse, nor any kind of spiny fish, nor sea-crawfish, nor the spotted nor the spiny dog-fish; and, again, from this lagoon, all the fishes, save only a little gudgeon, migrated seaward to breed. And though with no special application to the island, but only to the Asiatic coast in general, I may add that the chameleon, which is the subject of one of Aristotle's most perfect and minute investigations, is here comparatively common, but is not known to occur in Greece at all.

I take it then as probable, or even proven, that an important part of Aristotle's work in natural history was done upon the Asiatic coast, and in and near to Mitylene. He will be a lucky naturalist who shall go some day and spend a quiet summer by that calm lagoon, find there all the natural wealth ὅσσον Λέσβος . . . ἐντὸς ἐέργει, and have around his feet the creatures that Aristotle loved and knew. Moreover, it follows for certain, if all this be true, that Aristotle's biological studies preceded his more strictly philosophical work; and it is of no small importance that we should be (so far as possible) assured of this, when we speculate upon the influence of his biology on his philosophy.

Aristotle is no tyro in biology. When he writes upon mechanics or on physics, we read him with difficulty: his ways are not our ways; his explanations seem laboured; his science has an archaic look, as it were coming from another world to ours, a world before Galileo. Speaking with all diffidence, I have my doubts as to his mathematics. In spite of a certain formidable passage in the "Ethics," where we have a sort of *ethica more geometrico demonstrata,* favourite use of the equality of the angles of a triangle to four right angles, as an example of proof indisputable, in spite even of his treatise, "De Lineis Insecabilibus," I am tempted to suspect that he sometimes passed shyly beneath the superscription over Plato's door.

But he was, and is, a very great naturalist. When he treats of natural history, his language is our language, and his methods and his problems are well-nigh identical with our own. He had familiar knowledge of a thousand varied forms of life, of bird, and beast, and plant, and creeping thing: he was careful to note their least details of outward structure, and curious to probe by dissection into their parts within. He studied the metamorphoses of gnat and butterfly, and opened the bird's egg to find the mystery of incipient life in the developing chick. He recognised great problems of biology that are still ours to-day, problems of heredity, of sex, of nutrition and growth, of adaptation, of the struggle for existence, of the orderly sequence of nature's plan. Above all, he was a student of life itself. If he was a learned anatomist, a great student of the dead, still more was he a lover of the living. Evermore his world is in movement. The seed is growing, the heart beating, the frame breathing. The ways and habits of living things must be known: how they work and play, love and hate, feed and procreate, rear and tend their young; whether they dwell solitary, or in more and more organised companies and societies. All such things appeal to his imagination and his diligence. Even his anatomy becomes at once an *anatomia animata,* as Haller, poet and physiologist, was wont to describe the science to which he gave the name of physiology. This attitude towards life, such knowledge got thereby, afterwards helped to shape and mould Aristotle's philosophy.

I have no reason to suppose that the study of biology "maketh a man wise," but I am sure it helped

[1] From the Herbert Spencer lecture delivered at Oxford on February 14 by Prof. D'Arcy W. Thompson, C.B.

to lead Aristotle on the road to wisdom. Nevertheless he takes occasion to explain, or to excuse, his devotion to this study, alien, seemingly, to the pursuit of philosophy. "Doubtless," he says, "the glory of the heavenly bodies fills us with more delight than we gain from the contemplation of these lowly things; for the sun and stars are born not, neither do they decay, but are eternal and divine. But the heavens are high and afar off, and of celestial things the knowledge that our senses give us is scanty and dim. On the other hand, the living creatures are nigh at hand, and of each and all of them we may gain ample and certain knowledge if we so desire. If a statue please us, shall not the living fill us with delight; all the more if in the spirit of philosophy we search for causes and recognise the evidences of design. Then will nature's purpose and her deep-seated laws be everywhere revealed, all tending in her multitudinous work to one form or another of the beautiful." In somewhat similar words does Bacon retranslate a familiar saying: "He hath made all things beautiful according to their seasons; also he hath submitted the world to man's enquiry." On the other hand, a most distinguished philosopher of to-day is struck, and apparently perplexed, by "the awkward and grotesque, even the ludicrous and hideous forms of some plants and animals." I commend him, with all respect, to Aristotle– or to that Aristotelian verity given us in a nutshell by Rodin, "Il n'y a pas de laideur!"

To be sure, Aristotle's notion of beauty was not Rodin's. He had a philosopher's comprehension of the beautiful, as he had a great critic's knowledge and understanding of poetry; but wise and learned as he was, he was neither artist nor poet. His style seldom rises, and only in a few such passages as that which I have quoted, above its level didactic plane. Plato saw philosophy, astronomy, even mathematics, as in a vision; but Aristotle does not know this consummation of a dream. The bees have a king, with Aristotle. Had Plato told us of the kingdom of the bees, I think we should have had Shakespearian imagery. The king would have had his "officers of sorts," his magistrates, and soldiers, his "singing masons building roofs of gold." Even Pliny, arid encyclopædist as he is, can now and then throb and thrill us as Aristotle cannot do- for example, when he throws no little poetry and still more of music into his description of the nightingale's song.

But let us now come, at last, to exemplify, by a few brief citations, the nature and extent of Aristotle's zoological knowledge. Among the bloodless animals, as Aristotle called what we call the invertebrates, he distinguishes four great genera, and of these the Molluscs are one. These are the cuttle-fish, which have now surrendered their Aristotelian name of "molluscs" to that greater group, which is seen to include them, with the shellfish, or "ostracoderma" of Aristotle. These cuttle-fishes are creatures that we seldom see, but in the Mediterranean they are an article of food, and many kinds are known to the fishermen. All, or well-nigh all, of these many kinds were known to Aristotle, and his account of them has come down to us with singular completeness. He describes their form and their anatomy, their habits, their development, all with such faithful accuracy that what we can add to-day is of secondary importance. He begins with a methodical description of the general form, tells us of the body and fins, of the eight arms with their rows of suckers, of the abnormal position of the head. He points out the two long arms of Sepia and of the Calamaries, and their absence in the octopus; and he tells us, what was only confirmed of late, that with these two long arms the creature clings to the rock and sways about like a ship at anchor. He describes the great eyes, the two big teeth forming the beak; and he dissects the whole structure of the gut, with its long gullet, its round crop, its stomach, and the little coiled coecal diverticulum; dissecting not only one but several species, and noting differences that were not observed again until Cuvier re-dissected them. He describes the funnel and its relation to the mantle-sac, and the ink-bag, which he shows to be largest in Sepia of all others. And here, by the way, he seems to make one of those apparent errors that, as it happens, turn out to be justified; for he tells us that in Octopus the funnel is on the upper side, the fact being that when the creature lies prone upon the ground, with all its arms spread and flattened out, the funnel-tube (instead of being flattened out beneath the creature's prostrate body) is long enough to protrude upwards between arms and head, and to appear on one side or other thereof, in a position apparently the reverse of its natural one. He describes the character of the cuttle-bone in Sepia, and of the horny pen which takes its place in the various calamaries, and notes the lack of any similar structure in Octopus. He dissects in both sexes the reproductive organs, noting without exception all their essential and complicated parts; and he had figured these in his lost volume of anatomical diagrams. He describes the various kinds of eggs, and, with still more surprising knowledge, shows us the little embryo cuttle-fish, with its great yolk-sac, attached (in apparent contrast to the chick's) to the little creature's developing head.

But there is one other remarkable feature that he knew ages before it was rediscovered, almost in our own time. In certain male cuttle-fishes, in the breeding season, one of the arms develops in a curious fashion into a long coiled whip-lash, and in the act of breeding may then be transferred to the mantle-cavity of the female. Cuvier himself knew nothing of the nature or the function of this separated arm, and, indeed, if I am not mistaken, it was he who mistook it for a parasitic worm. But Aristotle tells us of its use and its temporary development, and of its structure in detail, and his description tallies closely with the accounts of the most recent writers.

Among the rarer species of the group he knew well the little Argonaut, with its beautiful cockle-shell, and tells how it puts up its two broad arms to sail with, a story that has been rejected by many, but that, after all, may perhaps be true.

Now in all this there is far more than a mass of fragmentary information gleaned from the fishermen. It is a plain orderly treatise, on the ways and habits, the varieties, and the anatomical structure, of an entire group. Until Cuvier wrote there was none so good, and Cuvier lacked knowledge that Aristotle possessed.

As exact and scarce less copious is the chapter in which Aristotle deals with the crab and lobster, and all such crustacean shell-fish, and that in which he treats of insects, after their kind. Most wonderful of all, perhaps, are those portions of his books in which he speaks of fishes, their diversities, their structure, their wanderings, and their food. Here we may read of fishes that have only recently been rediscovered,[2] of structures only lately re-investigated, of habits only of late made known.[3] And many such anticipations of our knowledge, and many allusions to things of which perhaps we are still ignorant, may yet be brought to light; for we are still far from having

[2] *E.g. Parasilurus aristotelis*, a siluroid fish of the Achelous.

[3] *E.g.* the reproduction of the pipe-fishes (Syngnathi), the hermaphrodite nature of the Serrani, the nest-building of the wrasses, &c.

interpreted and elucidated the whole mass of Aristotle's recorded erudition, which whole recorded mass is only, after all, *tanquam tabula naufragii.*

There is perhaps no chapter in the "Historia Animalium" more attractive to the anatomist than one which deals with the anatomy and mode of reproduction of the cartilaginous fishes, the sharks and rays, a chapter which moved to admiration that prince of anatomists Johannes Müller.[4] The latter wrote a volume on the text of a page of Aristotle, a page packed full of a multitude of facts, in no one of which did Johannes Müller discover a flaw. The subject is technical, but the gist of the matter is this: that among these Selachians (as, after Aristotle, we still sometimes call them) there are many diversities in the structure of the parts in question, and several distinct modes in which the young are brought forth or matured. For in many kinds an egg is laid, which eggs, by the way, Aristotle describes with great minuteness. Other kinds do not lay eggs, but bring forth their young alive, and those include the torpedo and numerous sharks or dogfish. The eggshell is in these cases very thin, and breaks before the birth of the young. But among them there are a couple of sharks, of which one species was within Aristotle's reach, where a very curious thing happens. Through the delicate membrane, which is all that is left of the eggshell, the great yolk-sac of the embryo becomes connected with the parental tissues, which infold and interweave with it; and by means of this temporary union the blood of the parent becomes the medium of nourishment for the young. And the whole arrangement is physiologically identical with what obtains in the higher animals, the mammals, or warm-blooded vivipara. It is true that the yolk-sac is not identical with that other embryonic membrane which comes in the mammals to discharge the function of which I speak; but Aristotle was aware of the difference, and distinguishes the two membranes with truth and accuracy.

It happens that of the particular genus of sharks to which this one belongs, there are two species differing by almost imperceptible characters; but it is in one only of the two, the γαλεὸς λεῖος of Aristotle, that this singular phenomenon of the *placenta vitellina* is found. It is found in the great blue shark of the Atlantic and the Mediterranean; but this creature has grown to a very large size before it breeds, and such great specimens are not likely to have come under Aristotle's hands. Cuvier detected the phenomenon in the blue shark, but paid little attention to it, and for all his knowledge of Aristotle, did not perceive that he was dealing with an important fact which the philosopher had studied and explained. In the seventeenth century, the anatomist Steno actually rediscovered the phenomenon, in the γαλεὸς λεῖος, the *Mustela laevis* itself, but he was unacquainted with Aristotle. And the very fact was again forgotten until Johannes Müller brought it to light, and showed not only how complete was Aristotle's account, but how wide must have been his survey of this class of fishes to enable him to record this peculiarity in its relation to their many differences of structure and reproductive habit. I used to think of this phenomenon as one that Aristotle might have learned from the fishermen, but after a more careful study of Johannes Müller's book, I am convinced that this is not the case. It was a discovery that could only have been made by a skilled and learned anatomist.

In a lengthy and beautiful account Aristotle describes the development of the chick. It is on the third day that the embryo becomes sufficiently formed for the modern student to begin its study, and it was after just three days (a little earlier, as Aristotle notes, in little birds, a little later in larger ones) that Aristotle saw the first clear indication of the embryo. Like a speck of blood, he saw the heart beating, and its two umbilical blood-vessels breaking out over the yolk. A little later he saw the whole form of the body, noting the disproportionate size of head and eyes, and found the two sets of blood-vessels leading, the one to the yolk-sac, the other to the new-formed allantois. In the tiny chick of the tenth day, he saw the stomach and other viscera; he noted the altered position of the heart and great blood-vessels; he traced clearly and fully the surrounding membranes; he opened the little eye, to seek, but failed to find, the lens. And at length he describes in detail the appearance and attitude of the little chick, the absorption of the yolk, the shrivelling of the membranes, just at the time when the little bird begins to chip the shell, and before it steps out into the world. While this account contains but a part of what Aristotle saw (and without a lens it would be hard to see more than he), it includes the notable fact of the early appearance of the heart, the *punctum saliens* of later writers, whose precedence of all other organs was a chief reason for Aristotle's attributing to it a common, central, or primary sense, and so locating in it the central seat of the soul. And so it was held to be until Harvey's time, who, noting the contemporaneous appearance of heart and blood, held that the contained was nobler than that which contained it, and that it was the blood that was "the fountain of life, the first to live, the last to die, the primary seat of the soul, the element in which, as in a fountain-head, the heat first and most abounds and flourishes"; so harking back to a physiology more ancient than Aristotle's—"for the blood is the life thereof." All students of the "Timaeus" know that here Aristotle parted company with Plato, who, following Hippocrates and Democritus, and others, placed the seat of sensation, the sovereign part of the soul, in the brain. Right or wrong, it was on observation, and on his rarer use of experiment,[5] that Aristotle depended. The wasp or the centipede still lives when either head or tail is amputated, the tortoise's heart beats when removed from the body, and the heart is the centre from which the blood-vessels spring. To these arguments Aristotle added the more idealistic belief that the seat of the soul, the ruling force of the body, must appropriately lie in the centre; and he found further confirmation of this view from a study of the embryo plant, where in the centre, between the seed-leaves, is the point from which stem and root grow. And Ogle reminds us how, until a hundred years ago, botanists still retained an affectionate and superstitious regard for that portion of the plant, calling it now *cor*, now *cerebrum*, the plant's heart or brain.

And now is it possible to trace directly the influence of Aristotle's scientific training and biological learning upon his sociology, his psychology, or in general on his philosophy? That such an influence must have been at work is, *prima facie*, obvious. The physician who becomes a philosopher will remain a physician to the end; the engineer will remain an engineer; and the ideas of pure mathematics, Roger Bacon's "alphabet of philosophy," will find issue and expression in the philosophy of such mathematicians as

[4] *Cf.* Cavolini, in his classical 'Mem. sulla Generazione dei Pesci," Naples, 1787: "E quando io . . . scorro la Storia degli Animali di Aristotile, non posso non essere da stupore preso, in esse leggende veduti quei fatti, che a noi non si son potuti che a stento manifestare: e rilevati poi con tutta la nettezza, e posti in parallelo coi fatti già riconosciuti nel feto del gallo;" &c.

[5] Aristotle's experiments were akin to Voltaire's, who employed himself in his garden at Ferney in cutting off the horns and heads of snails, to see whether, or how far, they grew again

Plato, Leibnitz, Spinoza, or Descartes. Moreover, it is not only the special training or prior avocation of the philosopher that so affects his mind. In divers historical periods the rapid progress or the diffused study of a particular science has moulded the philosophy of the time. So on a great scale in the present day does biology; so did an earlier phase of evolutionary biology affect Hegel; and in like manner, in the great days of Dalton and Lavoisier, did chemistry help, according to John Stuart Mill, to suggest a "chemistry of the mind" to the "association" psychologists? A certain philosopher,[6] in dealing with this theme, begins by telling us that "Mathematics was the only science that had outgrown its merest infancy among the Greeks." Now it is my particular purpose to-day to show, from Aristotle, that this is not the case. Whether Aristotle's biological forerunners were many or few, whether or not the Hippocratics (for instance) had failed to raise physiology and anatomy to the dignity of a science, or, having done so, had only reserved them, as a secret cult, to their own guild; in short, whether Aristotle's knowledge is in the main the outcome of his solitary labours, or whether, as Leibnitz said of Descartes, *praeclare in rem suam vertit aliorum cogitata,* it is at least certain that biology was in *his* hands a true and comprehensive science only second to the mathematics of his age.

The influence, then, of scientific study, and in particular of biology, is not far to seek in Aristotle's case. It has ever since been a course or plan to compare the State, the body politic, with an organism, but it was Aristotle who first employed the metaphor. Again, in his exhaustive accumulation and treatment of facts, his method is that of the observer, of the scientific student, and is in the main inductive. Just as, in order to understand fishes, he gathered all kinds together, recording their forms, their structure, and their habits, so he did with the constitutions of cities and of States. Those two hundred and more πολιτεῖαι which Aristotle laboriously compiled, after a method of which Plato would never have dreamed, were to form a natural history of constitutions and governments. And if we see in his concrete, objective treatment of the theme a kinship with Spencer's descriptive sociology, again, I think, a difference is soon apparent between Spencer's colder catalogue of facts and Aristotle's more loving insight into the doings and into the hearts, into the motives and the ambitions, of men.

But whatever else Aristotle is, he is the great Vitalist, the student of the body with the life thereof, the historian of the soul.

Now we have already seen how and where Aristotle fixed the soul's seat and local habitation. But the soul has furthermore to be studied according to its attributes, or analysed into its "parts." Its attributes can be variously analysed, as in his "Ethics" Aristotle shows. But it is in the light of biology alone that what amounts to a scientific analysis, such as is developed in the "De Anima," becomes possible; and in that treatise, it is only after a long preliminary physiological discussion that Aristotle at length formulates his distinctive psychology. There is a principle of continuity, a συνέχεια that runs through the scale of structure in living things, and so, little by little, by imperceptible steps, does nature make the passage from plant, through animal, to man: it is with all the knowledge summarised in a great passage of the "Natural History," and embodied in this broad generalisation, that he afterwards proceeds to indicate the same gradation in psychology, and to draw from it a kindred classification of the soul.

[6] Ritchie, "Darwin and Hegel," p. 39.

But observe that, though Aristotle follows the comparative method, and ends by tracing in the lower forms the phenomena incipient in the higher, he does not adopt the method so familiar to us all, on which Spencer insisted, of first dealing with the lowest, and of studying in successive chronological order the succession of higher forms. The historical method, the realistic method of the nineteenth century, the method to which we insistently cling, is not the only one. Indeed, even in modern biology, if we compare, for instance, the embryology of to-day with that of thirty years ago, we shall see that the pure historical method is relaxing something of its fascination and its hold. Rather has Aristotle continually in mind the highest of organisms, in the light of the integral and constituent phenomena of which must the less perfect be understood. So was it with one whom the Lord Chancellor of England has called "the greatest master of abstract thought since Aristotle died." For Hegel, as I feel sure for Aristotle, *Entwicklung* was not a "time-process but a thought-process." To Hegel, an actual, realistic, outward, historical evolution seemed but a clumsy and materialistic philosophy of nature. In a sense, the "time-difference has no interest for thought." And if the lower animals help us to understand ourselves, it is in a light reflected from the study of man.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At a meeting of the electors to the Plumian professorship of astronomy held on April 19 Mr. A. S. Eddington, chief assistant at the Royal Observatory, Greenwich, was elected into the professorship, in succession to the late Sir George Darwin.

The adjudicators of the Adams Prize for the period 1911–12 consider that the two essays submitted to them with the following titles are of distinction: "The Theory of Radiation," by Mr. S. B. McLaren, and "The Fundamental Spectra of Astrophysics," by Dr. J. W. Nicholson, between whom the prize is divided in equal shares.

OXFORD.—The Romanes lecture will be delivered on Thursday, May 8, at 3 p.m., by Sir W. M. Ramsay. The subject is "The Imperial Peace: an Ideal Pervading European History."

The Halley lecture will be delivered on Thursday, May 22, at 8.30 p.m., by Dr. Louis A. Bauer, of the Carnegie Institution of Washington, U.S.A. Subject, "The Earth's Magnetism." The lecture will be illustrated by lantern slides.

On Tuesday, April 22, Convocation authorised the expenditure of a sum not exceeding 6000*l.* for the erection of additional buildings forming an extension of the School of Rural Economy. The money will be provided partly by a grant from the Development Fund of the Treasury, and partly out of the sum presented to the University in 1912 by Mr. Walter Morrison for the promotion of the study of agriculture.

UNDER the title *Educação,* a new fortnightly twelve-page magazine has been started in Portugal, dealing with elementary education, and we have now received the current issues, which commence with January. It contains original articles and reviews, an interesting feature being the series of experiments in elementary physics classed under two categories, namely experiments performed with simple apparatus (such as coffee-pots, kitchen utensils, and the like) and experiments suited for a laboratory.

THE seventeenth annual conference of the Parents' National Educational Union will be held at the Caxton Hall, Victoria Street, S.W., on May 5. Among the subjects of papers are:—Education and social sympathy, J. St. G. Heath; the reading habit and a wide curriculum, Miss C. M. Mason; knowledge and learning, Stanley Leathes, C.B.; and knowledge and its relation to national efficiency, J. L. Paton. Further particulars may be obtained from Miss Parish, 26 Victoria Street, S.W.

THE University of Edinburgh announces the establishment, in October next, of a mathematical laboratory for practical instruction in numerical, graphical, and mechanical calculation and analysis, as required in applied mathematical sciences and for research in connection with the mathematical department. A course of practical work has been drawn up by Prof. E. T. Whittaker, F.R.S., including methods of interpolation, graphic solution of equations, practical Fourier analysis, use of calculating instruments, and calculations of elliptic functions, Bessel functions, gamma functions, and, indeed, new functions not previously tabulated. Prof. Whittaker proposes to give sufficient theoretical explanation to render the more advanced work intelligible to those who have not previously studied the functions of higher analysis.

THE Board of Agriculture and Fisheries proposes to award in October next twelve research scholarships in agricultural science, of the annual value of 150*l*., and tenable for three years. These scholarships have been established in order to train promising students under suitable supervision, with the view of their contributing to the development of agriculture, either by carrying out independent research, or by acting in an advisory capacity to agriculturists. They will be granted only to students who show distinct promise of capacity for advanced study and research in some one of the sciences bearing on agriculture. Applicants must be graduates of a university, or holders of a diploma of a university or college of university rank, and application should be made not later than June 9 on a form to be obtained from the secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

THE annual conference of the Association of Teachers in Technical Institutions will be held this year in Bradford at Whitsuntide. The proceedings will be opened on Whit-Monday, when the Lord Mayor of Bradford, Alderman Fred Foster, will officially welcome the conference to Bradford. This will be followed by the address of the president, Mr. P. Coleman, of the Northern Polytechnic Institute. The meeting on Tuesday evening will be addressed by the Right Hon. J. A. Pease, President of the Board of Education, and in view of the introduction of the new Education Bill soon after Whitsuntide, this address will be looked forward to with exceptional interest. This meeting will also be addressed by Dr. M. E. Sadler, Vice-Chancellor of the University of Leeds, Sir William Priestley, M.P., Sir Alfred Keogh, K.C.B., rector of the Imperial College of Science and Technology, Mr. F. W. Jowett, M.P., and others. Papers will be read to the conference on corporate life in a technical institution, by Mr. W. Hibbert, the Polytechnic, Regent Street; vocational education, by Mr. A. C. Coffin, director of education, Bradford, and coordination within a county area, by Mr. F. N. Cook, secretary for higher education in the West Riding of Yorkshire.

THE January issue of the Bulletin of the Massachusetts Institute of Technology contains the report of the president, Dr. R. C. Maclaurin, presented to the governing body of the institute in December last. Taken in conjunction with that of the previous year, the report shows that during the last eighteen months nearly 1,400,000*l*. has been paid or promised by way of gift to the Massachusetts Institute of Technology. The principal items include 600,000*l*. for buildings, 160,000*l*. for land, 320,000*l*. for general endowment, 150,000*l*. for endowment of the department of naval architecture, 40,000*l*. for scientific research, and 100,000*l*. for scholarships. It is not surprising to find that the institute attracts students from all parts of the United States, and, indeed, from all parts of the world. Students come in large numbers from China, South America, Canada, and in considerable numbers from Europe, India, Egypt, South Africa, and a few from Australia. The proportion of foreign students at the institute is more than double that at almost any other institution in the United States. The number of students on November 1 last reached 1611, the largest in the history of the institute. The total number of members of the teaching staff for these students was 254, of whom 56 were full professors, while there were, in addition, 16 research professors.

SOCIETIES AND ACADEMIES.

Royal Society, April 17.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. W. **Watson**: The luminosity curves of persons having normal and abnormal colour vision. The author has calculated the form of the luminosity curves corresponding to different degrees of deficiency of the red and green sensation, and shows that in the great majority of cases of colour blindness the observed points agree with the calculated curves, and hence the correctness of Sir W. Abney's sensation curves and his theory as to partial colour blindness is supported. The cases of abnormal luminosity curves given by persons having normal colour vision are shown to be probably due to variation in macular pigmentation.—Prof. W. H. **Bragg** and W. L. **Bragg**: The reflection of X-rays by crystals. The paper deals with the reflection of a beam of X-rays by the cleavage faces of various crystals, an ionisation method being employed to measure the strength of the reflected rays. The apparatus corresponds to a spectrometer, the parallel planes in which the atoms of the crystal are arranged taking the place of the lines of a grating, and the ionisation chamber that of a telescope. A fine slit in front of the X-ray bulb allows a beam of rays to fall on the face of the crystal, and both crystal and ionisation chamber turn about the axis of the instrument and can be set at any desired angles. By this method evidence has been found of the existence of three very homogeneous components in the rays from the bulb employed, which are only reflected from the crystal at definite angles. They show as a very strong reflection superimposed on the general reflection which takes place at all angles. Each of these has a definite absorption coefficient in aluminium, and can be recognised when reflected from many crystals. The absorption of the homogeneous rays in different metals corresponds in all respects to the absorption of characteristic X-rays.—Prof. J. C. **McLennan**: A fluorescence spectrum of iodine vapour.—Dr. W. **Wahl**: The relation between the crystal-symmetry of the simpler organic compounds and their molecular constitution. Part I.—Prof. H. E. **Armstrong** and E. E. **Walker**: Studies of the processes operative in solutions. XXVIII., The causes of variation in the optical rotatory power of organic compounds and of anomalous rotatory dispersive power. Attention is directed to the explanation of the anomalous rotatory dispersive power displayed by some organic compounds,

notably, the tartrates, which was given by Biot, the original discoverer of optical rotatory power, viz. that it may be due to the presence of two compounds of opposite rotatory power (+ and −) differing in rotatory dispersive power. This explanation appears to have been generally overlooked. The behaviour to be expected of compounds varying in their optical properties in different ways is discussed. The results arrived at serve to explain the apparently abnormal variation in optical behaviour often noticed in optically active compounds; they also appear to be of significance as indicating a relation among solvents generally and underlying their action towards substances generally of a very definite and regular character; each solvent would seem to have its definite sphere and mode of action, so that any two solvents behave relatively always in the same way towards solutes generally, apart from the exceptional cases in which some special property of the solute comes into operation to disturb regularity of action.

Geological Society, April 9.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. G. **Hickling**: The variation of *Planorbis multiformis*, Bronn. The writer gives an account of an investigation of the above-named Miocene gasteropod, based on a suite of 532 specimens from a single block of stone. A study was made of the variation in height presented by the shells, which include every gradation between perfectly discoid forms and types with a spire the height of which considerably exceeds the diameter of the base. By sorting the whole of the shells into ten grades, according to height, it was shown that forms of mean height were common, while extreme forms were rare, the height being distributed, in fact, according to a typical "variation-curve." If more than one species were really present, it is in the highest degree improbable that the various types should be distributed in the proportions actually found, and this is taken as the most satisfactory proof possible of the specific unity of the group. It is shown that the shells also vary extensively in respect of the amount of carination, the degree of involution, the form of cross-section of the whorls, the form of aperture, and the stage of development at which various characters are acquired, the variation in each character being, however, "continuous."—Miss M. Colley **March**: The structure and relationships of the Carbonicolæ. The evidence for the relationship of the Carbonicolæ to the Unionidæ, based on shell-structure, muscle-scars, form, habitat, ligament, and hinge-teeth, appears insufficient.

Physical Society, April 11.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—A. **Campbell** and H. C. **Booth**: Errors in magnetic testing due to elastic strain. In magnetic tests on sheet material considerable errors may occur if the sheets or strips are tested while in bent form. These errors, which are in general agreement with the known effects of compression and tension, were investigated experimentally with one or two forms of magnetic circuit similar to those sometimes occurring in practice.—Dr. G. W. C. **Kaye**: Note on kathodic sputtering. The paper gives an account of the volatilisation of an aluminium kathode in a discharge tube containing helium. The sputtered deposit on the glass indicates that, under the conditions which prevailed, the disintegration was restricted to the edges of the kathode and did not occur elsewhere. Accordingly the complete outline of the kathode (made by rolling a sheet of aluminium into a nearly complete cylinder) was traced out by the deposit on the walls of the tube.—A. **Campbell**: Vibration galvanometers with unifilar torsional control. The author exhibited a moving-coil vibration galvanometer in which a novel principle is used to obtain the fine adjustment of the control torque requisite for accurate tuning.

DUBLIN.

Royal Dublin Society, April 15.—Dr. James H. Pollok in the chair.—Prof. H. H. **Dixon** and W. R. G. **Atkins**: Extraction of zymase by freezing. Yeast frozen solid by exposure to liquid air, and centrifuged when thawed, gives up its sap. The sap thus extracted amounts to about one-third of the volume of the yeast originally treated. It is free from fermentable carbohydrates, but actively ferments cane-sugar when supplied to it. Its activity, in the samples examined, was as great as that of the extract prepared from the same samples by Lebedeff's maceration method. The method of extraction by means of liquid air has the advantage of great rapidity. Culture experiments show that the yeast is killed by exposure to the temperature of liquid air.—Prof. H. H. **Dixon** and W. R. G. **Atkins**: Osmotic pressures in plant organs. III., The osmotic pressure and electrical conductivity of yeast, beer, and wort. Measurements of osmotic pressure were made by the thermo-electric method of cryoscopy previously described. The yeast juice was obtained by freezing the yeast in liquid air and centrifuging the resultant liquid mass. It was found that ordinary yeast has an osmotic pressure of about 41 atm., that of wort being about 14. Thus there is a marked rise in pressure during fermentation. The impermeability of the yeast cell to electrolytes is shown by the conductivity of the juice being about four times as great as that of the beer, which is practically the same as that of the unfermented wort. Both the osmotic pressure and electrical conductivity of pressed yeast are greater than is the case in actively fermenting yeast.—R. Lloyd **Praeger**: The buoyancy of the seeds of some Britannic plants. The importance of the question of the buoyancy of seeds in water in connection with the dispersal and distribution of plants has been long recognised. The experiments of Darwin, Martins, Thuret, and Guppy lead to the generalisation that only about one-tenth of a flora bear seeds capable of more than a very brief period of buoyancy. The present experiments were undertaken in order to furnish further data for a study of the dispersal of our native species. Hitherto results were available for about 330 native species. The number of species tested is now raised to 900. The results bear out the conclusion already mentioned; also Guppy's conclusion that the buoyant seeds belong mainly to maritime and marsh species. Some results relating to fresh and dried fleshy fruits and also to fruiting branches are given.

PARIS.

Academy of Sciences, April 14.—M. F. Guyon in the chair.—Emile **Picard**: Application of the theory of integral equations to certain problems in the analytical theory of heat on the hypothesis of a sudden rise of temperature at the surface of separation of the bodies in contact.—J. **Boussinesq**: The velocity of slow fall of a liquid spherical drop, after becoming uniform, in a viscous liquid of slightly greater density than the falling drop.—M. **Landouzy** was elected a member of the section of free academicians in the place of the late M. Teisserenc de Bort.—G. de **Saint-Aubin**: An apparatus allowing of a variation of the carrying surface of an aëroplane. The apparatus consists of two auxiliary planes with surfaces of slight curvature, with their centres of sustentation for a given angle of attack on the same line passing through the centre of sustentation of the ordinary planes of the aëroplane. J. **Guillaume**: Observations of the sun made at the

Observatory of Lyons during the fourth quarter of 1912. Tables are given of the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude. Observations were possible on fifty-nine days.—J. **Lagrula**: A new method for the rapid visual search for the small planets. The method is based on the application of binocular vision, combined with the use of a coloured screen. The presence of a small planet in the field can be proved in less than a minute. An error of position of the asteroid 233, Asterope, was detected on the night of April 1 in less than five minutes.—M. **Tzitzéica**: A generalisation of non-Euclidean minimal surfaces.—G. **Valiron**: Integral functions of finite order.—Georges **Rémoundos**: The series and families of algebroid functions in a domain.—G. **Pólya**: The method of Graeffe.—M. **Gunther**: The characteristics of systems of partial differential equations.—Albert **Turpain**: The reception in the Morse code of radio-telegrams with simultaneous photographic record. Diagrams showing the results obtained by the system of relays described in an earlier communication (March 17).—M. de **Broglie**: The reflection of the Röntgen rays. Reproductions of photographs obtained by the reflection of Röntgen rays by various crystals at a grazing angle. The exact interpretation of the results is still uncertain.—H. **Guilleminot**: The variation of the electrical resistance of selenium when irradiated by the Röntgen rays and by radium rays. The results are given in a table showing the fall of resistance of a selenium cell under the action of the X-rays; a preliminary study of the effects of varying voltage and temperature was necessary. Similar measurements were made with exposure to radium rays, but the results are not given.—Camille **Matignon**: The reduction of magnesia by aluminium. A mixture of aluminium powder and magnesia, heated to 1200° C. in a vacuous steel tube, the upper portion of which was kept cool, gave metallic magnesium as crystals in the cold portion. The yield of magnesium was good.—L. C. **Maillard**: The formation of humus by the action of polypeptides on sugars.—Paul **Gaubert**: The polymorphism of codeine, thebaine, and narcotine. A new type of sphærolite.—L. **Collot**: The celestine of the sedimentary strata.—G. **André**: The evolution of the mineral and nitrogenous materials in some annual plants.—F. **Baco**: Comparative budding of grafted and ungrafted vines.—Jules **Glover**: An intensive physiological telephone. The action of the current on the receiving magnet of the telephone does not depend on its strength so much as on the variations in strength. The new arrangement described is based on the study of the physiological causes of these variations.—B. **Roussy**: The mathematical theory of the geometric law of the surface of the human body. The body is pictured as consisting of twenty-six truncated cones and a formula derived for obtaining the true surface. Various approximations are discussed.—Raphaël **Dubois**: Microzymas, coccoliths, and vacuolids.—Charles **Nicolle**, A. **Cuénod**, and L. **Blaizot**: Some properties of the virus of trachoma. Immunity in trachoma. The Algerian ape (*Macacus inuus*) contracts trachoma, but throws off the disease completely in from one to three months. Immunisation experiments were carried out on this animal with successful results; results of the application of similar treatment to man are also given.—Charles **Lepierre**: The replacement of zinc by uranium in the culture of *Aspergillus niger*. Uranium can replace zinc in Raulin's fluid; the stimulation of growth of the mould is less intense, however, with uranium than with zinc.—E. **Voisenet**: New researches on a ferment of bitter wines. A bacillus has been isolated, named *Bacillus amaracrylus*, which produces all the characteristics of bitterness in wines. It converts glycerol into acrolein, to which the bitter taste is due, the other products formed including hydrogen, carbon dioxide, ethyl alcohol, and various fatty acids.—M. **Piettre** and A. **Vila**: The preparation of fibrinogen by dialysis on saccharose syrup.—L. **Cayeux**: The sedimentary iron minerals considered in their relations with the destruction of mountain chains.—I. **Assada**: The levels of the Lyons plateau.—M. **Durand-Gréville**: The laws relating to wind-storms causing a kink in the barometric chart.—De Montessus de **Ballore**: Destructive earthquakes and atmospheric precipitations.

CALCUTTA.

Asiatic Society of Bengal, April 2.—R. **Gurney**: Entomostraca from Lake Tiberias. Dr. Annandale obtained eight species of Entomostraca in the Lake of Tiberias and in small pools near it. Eight other species were bred from earth taken from a dried-up pool between Tiberias and Nazareth. The collection does not comprise any forms hitherto unknown.—D. **Hooper**: Sarcocolla. This is a description of a drug known to the early Greek and Arabian physicians, and used largely in India. It is the gum of *Astragalus fasiculifolius*, Buissier, a spiny shrub growing in Persia. Chemical examination shows that it consists principally of a peculiar glucoside differing from saponin and glycyrrhizin.

BOOKS RECEIVED.

Bulletin International. Résumés des Travaux Présentés. Classe des Sciences Mathématiques, Naturelles et de la Médecine. xvii^e Année. Pp. iii+419+plates. (Prague: L'Académie de Sciences de l'Empereur François Joseph.)

Icones Plantarum Formosanarum nec non et Contributiones ad Floram Formosanam, or Icones of the Plants of Formosa, and Materials for a Flora of the Island, based on a Study of the Collections of the Botanical Survey of the Government of Formósa. By B. Hayata. Fasc. ii. Pp. ii+156+xl plates. (Taihoku: Bureau of Productive Industries, Government of Formosa.)

Reprints of Papers from the Science Laboratories of the University of Sydney, 1908–9 to 1911–12. (Sydney.)

A Manual of Agricultural Chemistry. By H. Ingle. Third edition. Pp. 397. (London: Scott, Greenwood and Son.) 7*s*. 6*d*. net.

The Fauna of British India, including Ceylon and Burma. Hymenoptera. Vol. iii. By C. Morley. Pp. xxxvi+531+1 plate. (London: Taylor and Francis.) 20*s*.

Nomography, or the Graphic Representation of Formulæ. By Capt. R. K. Hezlet. Pp. iv+54. (Woolwich: Royal Artillery Institution.) 2*s*. 6*d*.

A Handbook of Forestry. By W. F. A. Hudson. Pp. ix+82. (Watford: Cooper Laboratory for Economic Research.) 2*s*. 6*d*. net.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 95 Jahresversammlung vom 8–11 September 1912 in Altdorf. Teil I. Pp. vii+210+171+plates. Teil II. Pp. vii+251+2 plates. (Aarau: H. R. Sauerländer et Cie.)

The Works of Aristotle, translated into English. De Coloribus. By T. Loveday and E. S. Forster. (Oxford: Clarendon Press.) 5*s*. net.

A Manual of Petrology. By F. P. Mennell. Pp. iv+256. (London: Chapman and Hall, Ltd.) 7*s*. 6*d*. net.

The Conquest of Bread. By P. Kropotkin. Cheap edition. Pp. xvi+298. (London: Chapman and Hall, Ltd.) 1s. net.

Elementary Experimental Dynamics for Schools. By C. E. Ashford. Pp. viii+246. (Cambridge University Press.) 4s.

Vegetation of the Peak District. By Dr. C. E. Moss. Pp. x+235+plates. (Cambridge University Press.) 12s. net.

Die gnomonische Projektion in ihrer Anwendung auf kristallographische Aufgaben. By Dr. H. E. Boeke. Pp. iv+54. (Berlin: Gebrüder Borntraeger.) 3.50 marks.

Die Rehobother Bastards und das Bastardierungsproblem beim Menschen. By Dr. E. Fischer. Pp. vii+327+19 plates. (Jena: G. Fischer.) 16 marks.

E. Strasburger. Das botanische Praktikum. Fünfte Auflage. By Drs. E. Strasburger and M. Koernicke. Pp. xxvi+860. (Jena: G. Fischer.) 24 marks.

Proceedings of the London Mathematical Society. Second series. Vol. xi. Pp. xlviii+482. (London: F. Hodgson.)

IVe Conférence Internationale de Génétique, Paris, 1911. Comptes rendus et rapports. Edited by P. de Vilmorin. Pp. x+571. (Paris: Masson et Cie.) 25 francs.

Elementary Practical Mathematics. By Prof. J. Perry. Pp. xiv+335. (London: Macmillan and Co., Ltd.) 6s.

DIARY OF SOCIETIES.

THURSDAY, April 24.

Royal Society, at 4.30.—(1) Protostigmata in Ascidians; (2) The Origin of the Ascidian Mouth: A. G. Huntsman.—Experiments on the Kidneys of the Frog: F. A. Bainbridge, S. H. Collins, and J. A. Menzies.—(1) The Probable Value to *Bacillus coli* of "Slime" Formation in Soils; (2) Variation in *B. coli*. The Production of Two Permanent Varieties from One Original Strain by Means of Brilliant Green: Cecil Revis.

Royal Institution, at 3.—The Progress of Hittite Studies. II. Religious Monuments of Asia Minor: Prof. J. Garstang.

Society of Dyers and Colourists (London Secrion), at 8.—The Chemistry of the Vat Dyes: E. de B. Barnett.

Institution of Electrical Engineers, at 8.—Phase-Advancing: Dr. G. Kapp.

Concrete Institute, at 7.30.—Discussion on Reports of the Science Standing Committee on: (1) A Standard Notation for Structural Engineering Calculations; (2) A Standard Specification for Reinforced Concrete Work; (3) Standard Connections and Joints in Reinforced Concrete.

FRIDAY, April 25.

Royal Institution, at 9.—Meroë: Four Years' Excavations of the Ancient Ethiopian Capital: Prof. J. Garstang.

Physical Society, at 5.—A Graphic Method of Optical Imagery: W. R. Bower.—Spectroscopic Resolution of a Graph: Dr. C. V. Burton.—Some Experiments to Detect β-rays from Radium-A: Dr. W. Makower and Dr. S. Russ.

MONDAY, April 28.

Royal Society of Arts, at 8.—Antiseptics and Disinfectants. II.: Dr. D. Sommerville.

Royal Geographical Society, at 8.30.—400th Anniversary of the Discovery of the Pacific Ocean by Blasco Nunez de Balboa: Sir Clements R. Markham, K.C.B.

Institute of Actuaries, at 5.—An Investigation into the Effects of Family and Personal History upon the Rates of Mortality Experienced in Various Classes of Life Assurance Risks, with Special Reference to Tuberculosis: E. A. Rusher and C. W. Kenchington.

Institution of Civil Engineers, at 8.—Law in Relation to Engineering: T. F. Thomson.

TUESDAY, April 29.

Royal Institution, at 3.—Recent Physiological Inquiries. I. Motion and Locomotion: Prof. W. Stirling.

Illuminating Engineering Society, at 7.30.—*Discussion*: Standard Clauses for Inclusion in a Specification of Street-lighting: A. P. Trotter.

Institution of Civil Engineers, at 8.—Annual General Meeting.

WEDNESDAY, April 30.

Royal Society of Arts, at 8.—The Science Museum: Dr. F. G. Ogilvie.

British Astronomical Association, at 5.—The Spectra of Comets: Prof. A. Fowler.—A Popular Star Finder: G. F. Chambers.—Seeing: J. W. Worthington.

THURSDAY, May 1.

Royal Society, at 4.30.—*Probable Papers*: The Capacity for Heat of Metals at Different Temperatures: Dr. E. H. Griffiths and Ezer Griffiths.—The Transition from the Elastic to the Plastic State in Mild Steel: A. Robertson and G. Cook.—Studies of the Processes Operative in Solutions XXVIII. The Influence of Acids on the Rotatory Power of Cane Sugar, of Glucose and of Fructose: F. P. Worley.—The Attainment of High Potentials by the Use of Radium: H. G. J. Moseley.—The Decrease in Velocity of α Particles in passing through Matter: E. Marsden and Dr. T. S. Taylor.

Royal Institution, at 3.—The Progress of Hittite Studies. III. Cults of Northern Syria: Prof. J. Garstang.

Institution of Electrical Engineers, at 8.—The Use of the Electrostatic System for the Measurement of Power: C. C. Paterson, E. H. Rayner, and A. Kinnes.

Linnean Society, at 8.—The Structure of the Wood of East Indian Species of Pinus: Prof. P. Groom and W. Rushton.—Branching Specimens of *Lyginodendron oldhamium*, Will: Dr. Winifred Brenchley.—A Problem in Weismannism: A. C. F. Morgan.—Note on *Sphenopus marsupialis*: Mrs. L. J. Wilsmore.—Polychæta of the Indian Ocean, with some Species from the Cape Verde Islands—The Serpulidæ, with a Classification of the Genera Hydroides and Eupomatus: Miss Helen L. M. Pixell.—Report on the Arachnida of the Seychelles: S. Hirst.—*Gypsina plana*, Carter: Miss Marjorie Lindsay.—Nitidulæ, Heterocidæ: A. Grouvelle.—Pselaphidæ de l'Archipel des Seychelles: A. Raffray.—Anthribidæ of the Seychelles: Dr. K. Jordan.—Hispinæ from the Seychelles: S. Maulik.

FRIDAY, May 2.

Royal Institution, at 9.—Blood Parasites: H. G. Plimmer.

CONTENTS.

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The Carbonisation of [redacted] Scientific Review of the Formation, Composition and Destructive Distillation of Coal for Gas, Coke and By-Products. By Prof. V. B. Lewes. Pp. xiv + 315. (London: John Allan and Co., 1912.) Price 7*s.* 6*d.* net.

THIS book is a welcome addition to the literature of a subject which is increasing in importance with each successive decade. Practical men are at length beginning to realise that the utilisation of the store of potential energy in coal by more rational methods than have hitherto prevailed is a problem that has to be grappled with seriously if our supremacy in the chief manufactured products of the world is to be maintained. Authorities of the highest competence have repeatedly pointed out that enormous economies might be effected if more scientific—that is, more common-sense—methods were employed in the consumption of coal. The waste is universal and extends practically to every industry, although in some to a much greater extent than in others. In the blast furnaces it is relatively small, for the reason that ever since the introduction of the hot-blast, the connection between potential energy and output has received an amount of consideration such as has not been bestowed upon any other aspect of the general problem. On railways, in factories, in brickworks, potteries and glassworks the waste is simply appalling.

It has been calculated that our annual consumption of coal is from 143 to 168 million tons per annum, of which from 30 to 36 million tons are used for domestic purposes. Of this huge amount it is estimated that from 40 to 60 million tons are practically wasted; that is, this quantity could be saved if gas-generating plant, electric motor and traction, gas heating and gas cooking, briquettes and coke were more generally employed than they are at present.

We think, therefore, that Prof. Lewes has been amply justified in putting together and in enlarging his Cantor lectures on the carbonisation of coal, given to the Society of Arts in 1911, and we trust that his appeal to a wider public will meet with the success it undoubtedly merits. The subject, indeed, is admittedly of national importance, but the fear is that this country will only waken up to the full significance of that fact when the pinch of necessity has tightened to a real grip—so tight, indeed, that it will be too late to shake it off.

The purpose of this work is to point out how the methods known comprehensively as "carbonisation processes"—that is, processes involving the preliminary treatment of coal by heating it under such conditions that initial products are formed capable of being turned to economical account as sources of power—may tend to minimise this waste. To understand fully the *rationale* of the effect of heat upon coal implies some knowledge of the proximate nature of coal and of the essential differences in composition between one coal and another. On this matter knowledge is confessedly very imperfect, but at the same time a certain amount of information has been gained by the study of the action of various solvents upon coal and by an examination of the nature of the products so obtained, as well as of the changes which the coal has experienced by the treatment. Incidentally, Prof. Lewes has been led to speak of the influence of storage, *i.e.* oxidation, on the nature of coal, and its effect on its coking properties and on the products of its destructive distillation. He is naturally induced to treat of the causes of the spontaneous ignition of coal, and he points out that the phenomenon is certainly more complicated than is generally supposed, and is not wholly, or in all cases, due to the occurrence of "brasses," or any readily oxidisable form of finely divided iron sulphide, but is connected with the character of its proximate constituents.

A special chapter is devoted to the question of the classification of the various kinds of coal. Strictly speaking, the most rational method would be one dependent upon proximate composition, and perhaps in time to come we may arrive at such a system. At present our knowledge on this matter is far too partial and imperfect to warrant even the attempt, and accordingly we have to content ourselves with the admittedly empirical and irrational systems which the metallurgists have devised for us. Of course, in practice, the systems we owe to Fleck, Gruner, Seyler and others—mainly German and Austrian writers—have a certain measure of convenience, and are probably remotely based upon intrinsic differences of chemical nature, but the correlation has not been definitely traced, and is certainly not capable of being stated with precision.

The greater part of the rest of the work is concerned with the effect of heat upon coal, or, to speak more precisely, on its behaviour during the process of destructive distillation. Of course, this is a very wide subject, and has been treated at great length in many standard treatises. It has, however, not been Prof. Lewes's object to traverse well-trodden ground. His purpose has been rather to direct attention to novel points, or to offer his testimony on disputed matters. This

feature of the work will commend it to the attention of those who are concerned practically with the carbonisation of coal, whether in gas manufacture, coke-oven work or tar distillation. They may not always agree with Prof. Lewes, but it will be admitted that he speaks as a well-trained chemist with the experience of a generation on practically every aspect of the subject, and that his opinions are fairly and temperately stated, such as becomes a man of science whose sole object is to elucidate the facts.

A commendable feature of the book is the excellence of the illustrations. Many of them are novel and all are of the character that experts will appreciate.

T. E. THORPE.

THE TRAINING OF GOLDSMITHS.

Metalwork and Enamelling: a Practical Treatise on Gold- and Silver-smiths' Work and their Allied Crafts. By Herbert Maryon. Pp. xiii+327+plates. (London: Chapman and Hall, Ltd., 1912.) Price 7*s*. 6*d*. net.

THE abolition of the apprenticeship system of training and the establishment of technical institutions for the education of young goldsmiths and silversmiths have created a demand for text-books which have in view the wants both of technical students and of those who are already practically engaged in these crafts.

The modern practice whereby the worker in the precious metals confines himself to a single branch of the craft results in technical skilfulness and in cheapness of production, but its influence is definitely against the production of craftsmen who are masters of their art. There will, however, always be a demand, and we hope an increasing demand, for work executed throughout by one man—a man who can both design and carry the work through—and text-books which will assist in the production of such men are rendering great service to the ancient craft of precious metal working. The information must be given in a form not too academic, and expressed in language that the worker of ordinary intelligence can understand.

This book is an important addition to this class of technical literature, and will be of value not only to the student but to those already engaged in gold- and silver-smiths' work. It deals with metalwork and enamelling from the essentially practical and technical rather than from the artistic or historical point of view. The author has departed from the course adopted by most writers on the subject, which consists in describing in detail the making of single articles, such as a brooch, cup, or casket.

The operations of soldering, raising, stone-setting, enamelling, &c., are fully discussed in a clear and concise manner, and the descriptions are accompanied by good illustrations.

Two chapters are devoted to a description of the materials and tools used, and to the making of small tools required for special work. The sharpening, hardening, and tempering of tools, which are matters of considerable importance to the craftsman, have also been dealt with. Designing, which is the essential basis of the gold- and silver-smiths' art, is ably discussed, and the method of teaching design adopted by Mr. Catterson Smith, at the Birmingham Municipal School of Art, for training lads who propose to enter the jewellery and metal trades is described and well illustrated.

Twenty-three plates illustrative of some of the finest examples of Greek, Etruscan, Renaissance, Celtic, and modern gold- and silver-smiths' work are given. These are taken from masterpieces exhibited in the British Museum and the Victoria and Albert Museum, and the publishers are to be highly congratulated on the excellent way in which these have been reproduced. The plates, which are fully described, will be of considerable assistance to students in studying the numerous styles of ornamentation, &c. A short chapter on the life and work of Benvenuto Cellini is appended.

A bibliography is given, but several important modern works have been omitted.

ERNEST A. SMITH.

GAS, OIL AND PETROL ENGINES.

The Gas, Petrol and Oil Engine. Vol. ii.: The Gas, Petrol and Oil Engine in Practice. By Dr. Dugald Clerk, F.R.S., and G. A. Burls. New and revised edition. Pp. viii+838. (London: Longmans, Green and Co., 1913.) Price 25*s*. net.

THE first volume of this book, which we reviewed some three years ago (November 11, 1909), was devoted chiefly to thermodynamics. Dr. Dugald Clerk, with the help of Mr. Burls, has now issued the companion volume treating of the gas, petrol and oil engine in practice. The current volume is much bulkier than its predecessor, and is one calling more for the skill of an editor in its composition than for that of an author. "Practice" with gas, oil and petrol engines now covers such a ramification of diverse uses that it is exceedingly difficult to write any treatise on the subject which shall show at the same time breadth of knowledge and unity of conception; and it is characteristic of Dr. Clerk's writings that the former is always the more pronounced.

In the present volume we have one-third of the chapters attributed to each of the two authors, and the remainder a joint production, whilst the whole "correctly represents the opinions of both writers." The subjects dealt with in the various chapters include the development of the Otto and Clerk cycles, ignition arrangements, speed regulation, governing, gaseous fuels, petroleum and its products, petrol engines, carburettors, heavy oil engines, marine engines, and the future of internal combustion motors. There is also a somewhat forbidding appendix on the acceleration of reciprocating parts.

Since its first publication in 1886 the book has had for numerous reasons to be increased greatly. It is only in comparatively recent years that the petrol engine has become prominent; now, of course, it is without exception the most widespread of all prime movers. In this volume Mr. Burls deals chiefly with the petrol engine, and he has certainly made it an interesting part of the book; he discusses ably and fully those problems on which he is well known to hold decided views, although his processes of argument are occasionally obscure, especially when mathematical treatment becomes necessary. The graphical construction at the early part of chapter iv. for finding the tangential effort at the crank-pin is unnecessarily complicated, and is not likely to be much used.

A very interesting statement occurs on p. 433, where Dr. Clerk describes his method of overcoming the pre-ignition difficulty when working with coke-oven gas or with other gases rich in hydrogen. His plan is to replace some of the air in the gaseous charge by cooled exhaust products; the effect is thus described: "The inert gas addition reduces inflammability by diminishing the oxygen and by the diluting effect of the carbonic acid and nitrogen, without reducing the total mass of the charge." This is a most ingenious plan, and it would be interesting to learn how much of its beneficial effect is due to the lowering of the compression temperature on account of the greater specific heat of the carbonic acid, particularly at the higher temperatures.

The most useful recent work on the theory of the internal combustion engine has been done by the Gaseous Explosions Committee of the British Association, of which until quite lately Dr. Clerk was joint secretary. One of their discoveries was the enormous proportion of the heat loss during the expansion stroke which occurred at the crest of the temperature wave. This was shown to be a radiation loss and not a surface-cooling loss. Nevertheless, we see on p. 517 that the rating of petrol engines is discussed on the basis of the heat loss being proportional to exposed surface irrespective of temperature limits, and it would have been better to have added to this assumption some qualification.

These are, however, minor points, and for the book as a whole we have only praise. We have no doubt it will be welcomed by British engineers, who are accustomed to look on Dr. Clerk as the chief authority on all that pertains to the gas engine. His concluding remarks cannot fail to hold not only engineers, but all who are interested in the future of the internal combustion motor. Dr. Clerk considers that although the problem of improving efficiency is a fascinating one from the scientific point of view, it is not at present of vital importance, since present thermal efficiencies are sufficiently good, and it is, he considers, much more important to improve internal combustion engines in other respects. He foresees much difficulty in the way of making a gas turbine, and suggests that progress is most likely to lie in the development of the Humphrey idea, in which water propelled by gaseous explosions is made to do work in turbines. He thinks also that more attention should be concentrated on the bituminous fuel producer as a means of gas production, since for this country coal is and must long remain the chief source of power.

COMPARATIVE BIOLOGY.

(1) *Vorlesungen über vergleichende Tier- und Pflanzenkunde.* By Prof. Adolf Wagner. Pp. viii+518. (Leipzig: Wilhelm Engelmann, 1912.) Price 11 marks.

(2) *Vergleichende Physiologie wirbelloser Tiere.* By Prof. H. Jordan. Erster Band: Die Ernährung. Pp. xxii+738. (Jena: Gustav Fischer, 1913.) Price 24 marks.

(1) THIS excellent book is a sequel to Claude Bernard's famous "Leçons sur les phénomènes de la vie communs aux animaux et aux végétaux" (1878), and we are aware that this is saying a great deal. It has not the luminosity and fascination of the French classic, but it is a substantial and original piece of work, to which we would give the heartiest welcome. Many books have compared the plant cell and the animal cell, the plant metabolism and the animal metabolism, and so on, but Prof. Wagner's aim is different. It is to show how the plant-organism and the animal-organism tackle the everyday problems of life. Organisations built on different lines find different, but in their way equally successful, solutions of the same problems, and the comparative study has been too much neglected. We have in this book an admirable guide.

The lectures begin with nutrition—the taking in of food, the treatment of this food within the body, its distribution, storage, and transformation, and so on. The respiratory function in plants and animals is then dealt with. Then follow very interesting lectures on movement and irritability, and the author is particularly successful in his treatment of the various senses in plants and animals. The general facts and laws of response to various kinds of stimulus are admirably discussed, and the lectures end with an inquiry into the regulation and unification of functions. The reproductive function has been left for separate treatment.

Prof. Wagner has given us a very thoughtful book, which makes one reflective, and to our mind there is convincingness in its cumulative argument that biology is autonomous, and that it cannot do its own business with the instruments of chemistry and physics alone. Thus we are led at the end of these lectures to a deliberate, but by no means dogmatic, "Psycho-biology."

(2) Prof. Jordan has tackled an enormous piece of work—a comparative physiology of the invertebrates—and he is to be congratulated on the completion of the first volume, which deals with nutrition. With colossal learning, which must have meant many years of work, he discusses the nutritive function in the various classes. Incidentally, he has a good deal to say in regard to habits. The material is very well arranged; the style is clear; there are numerous good figures; and there is an index of about seventy pages. Prof. Jordan has himself made numerous contributions to comparative physiology, and he is at once critical and fair in the way he deals with the huge mass of facts which the active prosecution of a relatively young inquiry has placed at his disposal. After tracing the nutritive functions from class to class, he takes in the concluding chapter an interesting general survey of the different kinds of diet, the different ferments, the processes of secretion, digestion, and absorption, the *rôle* of phagocytes, and the process of storage. Zoologists and physiologists will be grateful to Prof. Jordan for this valuable book of reference.

OUR BOOKSHELF.

Notes on Sampling and Testing. Second edition: revised and enlarged. Pp. 96+plates. (Manchester: Marsden and Co., Ltd., 1913.) Price 1*s.* 6*d.*

THE testing-house of the Manchester Chamber of Commerce was established some eighteen years ago for the examination of yarn and cloth as regards proportion of moisture, "strength," and other physical properties. To these objects have since been added others, including the analysis of sizing materials used on textile fabrics; the testing of wood pulp, oils, metals, fuels, and water; and also investigations respecting the causes of defects in fabrics—for example, mildew, stains, and "tenderness" or deficiency in strength. The handbook contains notes explaining certain of the processes used, the standards adopted, and the reasons for the choice of methods and standards. Examples of calculations are given, and tables of numerical data, with various diagrams and curves, one showing, for instance, the effect of atmospheric moisture on the strength of different kinds of cloth. Notes on the precautions to be taken in sampling articles for testing are included.

The services of the testing-house are not restricted to the members of the Chamber of Commerce, but are available to the public generally: and during the last ten years the number of samples submitted annually has more than doubled. One notable function of the establishment is to afford help in settling differences between manufacturers or merchants, especially where the experience of the testing-house is of value and analyses are required.

For those interested in textile industries, to whom it is more particularly addressed, the book will no doubt prove useful.

Physik der Gestirne. (Bücher der Naturwissenschaft. Vol. xiii.) By Prof. J. B. Messerschmitt. Pp. 195+13 plates. (Leipzig: Philipp Reclam, jun., n.d.) Price 1 mark.

FOR German readers this small volume affords an interesting and useful summary of the astrophysics of to-day. The introductory chapters deal with spectrum analysis in general, the solar spectrum and the spectroscope; the various conditions, *e.g.*, pressure, radial motion and magnetic fields, which modify the radiation are briefly but sufficiently discussed.

A considerable space is devoted to solar physics; and, for so small a volume, the general principles are stated very clearly and completely. On debatable subjects, such as the spectroscopic proof of water-vapour in the Martian atmosphere, Prof. Messerschmitt is commendably reserved, and states the views of both sides with judicial equanimity. More space might usefully have been devoted to the subject of stellar spectra, but the main points are enumerated, and a short, special chapter is devoted to the consideration of stellar temperatures.

Various tables, such as that showing the brightness of the sun's surface at different distances from the centre, and another giving the relative brightness of the chief nebula line in various nebulæ, afford the student a clear view of many important special problems, while the excellent plates will go far in fixing the general ideas in his mind.

W. E. R.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Atmospheric Electrification during Dust-storms.

OBSERVATIONS which have been made at the Patna College since the beginning of the present year indicate that the remarkably high negative potential gradient noticed as a feature of South African dust-storms in Prof. Rudge's letter, published in NATURE of March 13, also exists while the ordinary westerly winds of the hot weather are blowing in north India. At Patna they usually blow from about 9 a.m. to 6 p.m. from the middle of March until June, and they raise a great deal of dust, though the real dust-storms seldom occur so far to the east of India. This year they are unusually late in starting, and their place has been taken on most days by east winds, during which the potential gradient is of the ordinary positive type and magnitude.

So far, measurements have only been made with a portable electrometer and water dropper, the latter mounted on a post 5·6 metres from the ground with good exposure. Until March 15 nothing abnormal was noticed. The positive gradient was rather lower than usually recorded, seldom exceeding 60 volts per metre. Negative gradients of about 30 were measured on the afternoons of January 19 and March 11, but only lasted for a few minutes. At 3 p.m. on March 15, with a hot west wind blowing in gusts, the negative gradient was about 120 volts per metre. Under similar conditions on March 16 it rose to above 400 during some of the stronger gusts. On March 23, when the wind had once more shifted to the west, the negative gradient was too high to be measured with the electrometer.

Since the copy of NATURE containing Prof. Rudge's letter reached me, April 7 has been the only day with a strong west wind. On the morning of April 6 a squall, due to a local disturbance, blew from the north from 9 to 11 a.m. It raised a certain amount of dust on the sandbanks of the Ganges, but the atmosphere was unusually clear. While the wind was blowing hard the negative gradient was about 180 volts per metre, but this gradually diminished as the wind died away, and the usual positive gradient was re-established about 11.30 a.m.

A summary of the observations made on April 7 is given below:—

Time	Gradient (volts per metre)
7.15 a.m.	24+
9.10	32−
11.30	420− rising to 500−
12 noon	much above 500−
1 p.m.	" " 500−
2	about 1500−
3	" 1650−
5.30	180−
6.30	30+
8.30	above 250+
10	about 250+
10.20	130+
12	100+
12.30	36+

The rough value at 2 p.m. was obtained by a spark micrometer, the sparks being from 1·9 to 2 mm. in length. At 3 p.m. the water dropper was mounted on another post 1·6 metres from the ground, and it was just possible to measure the potential with the electrometer. After 10 p.m. the wind began to veer to the east, and it has remained in that quarter.

It is evident that a continuous record of these changes would have resembled Prof. Rudge's record of a severe dust-storm, except that the latter does not show such marked signs of a high positive gradient after sunset. Later on in the season even higher negative gradients will probably be observed, for the conditions on April 7 were scarcely typical of the hot weather, the temperature not rising above 94 and the clouds of dust not dense.

More measurements are, of course, necessary, but at present it does not appear unreasonable to suppose that from about 9 a.m. to 6 p.m. on the majority of days from March or April until June the potential gradient over a large portion of north India is reversed, and that under these conditions the negative gradient is from ten to fifty times as great as the ordinary positive change.

V. H. JACKSON.

Bankipore, April 9.

X-Rays and Crystals.

IN my former letter of March 18 (published in NATURE of April 10) I briefly pointed out that the transmitted beams of X-rays may be made visible by means of an ordinary fluorescent screen. The results of further experiments by visual method are favourable for the explanation suggested by Barkla and Bragg, in so far as the planes rich in molecules or atoms behave as reflecting planes for rays at grazing incidence.

A piece of colourless transparent fluorspar, crystallised in regular octahedron, and rock-salt in the form of a cube, were examined, with an incident beam of 1 cm. diameter. As already noticed, groups of transmitted beams are arranged on circular cones, always in contact with the incident beam, having their common vertex in the crystal, and *their axes fixed relative to it*, so that all the spots belonging to a certain cone converge into the central incident spot, as the axis corresponding to the cone approaches the incident beam. Moreover, the elongated spots are all directed towards the point of the cone diametrically opposite to the incident spot. By rotating the crystal about one of its principal axes, or about an axis bisecting the angle between two principal axes, the position of the axes of these cones was determined, leading to the result that all these axes correspond with the lines of intersection of several planes "rich in" reflecting particles, if we assume that these points are arranged in a simple space-lattice. The number of spots belonging to every cone may also be accounted for on this assumption. Even the brightness seems to conform with the "richness" of these points in the corresponding plane.

I was also able to reconstruct graphically the complete sets of spots shown in the photographs obtained by Laue, Friedrichs, and Knipping (Figs. 5 and 7) on the above assumption. Details of the investigation will appear in the near future in the Proceedings of the Tokyo Mathematico-Physical Society.

T. TERADA.

Physical Institute, Tokyo, April 6.

The Use of Alcyonarians as Money.

THERE has just been presented to the Royal Scottish Museum by Dr. E. MacKenzie, of Espiritu Santo, New Hebrides, a large Cœlenterate colony found on the shores of the island after a storm. Dr. MacKenzie supplies the information that such colonies are held in great esteem by the natives, who use them as charms,

wearing constantly a few twigs contained in a small bag or basket slung to the wrist, in the assurance that so good fortune will follow. But few other than chiefs are fortunate enough to possess this valuable jetsam. The twigs are also used as a medium of barter, a fragment of a colony, say, a branch seven or eight inches long, with its associated branchlets, having the exchange value of half a dozen pigs—the staple wealth of the island—or a wife.

In view of these interesting customs a few particulars regarding the Alcyonarian colony referred to are given. The specimen in the museum is a large and much-branched Gorgonid axis, intensely black in colour, with shiny surface marked by many fine grooves and ridges, and entirely devoid of flesh or spicules. By the characters of colour, branching, and general structure of the axis it is clearly a "black coral"—the "schwarze Horncoralle"—*Gorgonia* (now *Plexaura*) *antipathes* of Esper, or some closely related species. Such forms are widely distributed in Oceania, and are known to the natives by various names, frequently signifying "sea-wood," "sea-roots," "iron-wood," and such like. The present specimen is more than 2 ft. high, but examples 5 or 6 ft. high are on record. The colonies are most frequently cast ashore after storms, but they grow in five to six fathoms off Amboina, and belong to a typically shallow-water family.

It is natural that the large and thick stems of very old colonies used by East Indian peoples for the manufacture of ornaments should be considered of great value, but it is peculiar that the small twigs of an Alcyonarian widely distributed in Polynesia, an inhabitant of shallow water, and therefore likely to be often cast ashore, should be sufficiently rare in Santo to be a highly coveted medium of exchange.

JAMES RITCHIE.

The Royal Scottish Museum, Edinburgh, April 18.

Mechanically-formed Grikes in Sandstone.

THE grikes, or channels, frequently formed by the corrosive action of carbonic and organic acids upon the surfaces of exposed limestone beds are known to most geologists, but a case I recently met with, where similar surface-features have been naturally produced upon a sandstone ledge footing a part of the cliff at Orcombe Point, near Exmouth, is, I venture to think, a phase of marine erosion sufficiently unusual to merit a detailed description.

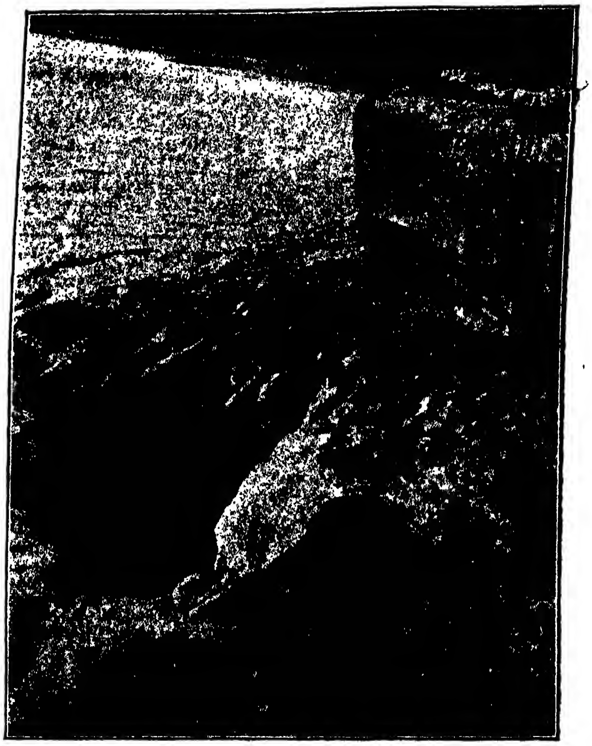
Here the Red Marls, with intercalated sandstones, rest on Permian (?) Sandstone. This, owing to its superior hardness, forms a ledge rising abruptly from the beach to a height of about 9 ft. This ledge of sandstone, which has a fairly level surface, is backed by a mass of a somewhat softer variety in the cliff, which, at its greatest distance, is about 20 ft. from the margin of the ledge.

The surface of this ledge is grooved and channelled to a remarkable extent, and presents an appearance similar to that of limestone grikes. The longest channel has a length of between 15 and 16 feet, the deepest is 2 ft. 3 in. in depth, and the widest has a width of about 2 ft. at the top. In this widest channel is a ridge, about 1 ft. from the top, running along its centre, clearly representing an eroded parting which originally separated this widest channel into two parts. All the channels run seawards, and are deepest near the edge of the ledge. They are veritable cañons in miniature. A photograph taken from a point above the surface of the ledge is here reproduced.

These unusual features have been produced as follows:—During stormy weather the pebbles, grit, and sand on the beach are cast upon the ledge by the waves. The advancing and receding water causes the beach material to move to and fro on the top of the ledge, and thus the pebbles and sand have literally sawn out these grooves, and the work of deepening and enlarging still goes on.

The position and direction of the channels was probably originally determined by slight "fossil" ripple-marks which existed on the surface of the rock.

The sandstone forming the ledge is a fairly hard,



Grikes in sandstone at Orcombe Point, near Exmouth (looking west).

red, ferruginous rock, composed chiefly of quartz grains, the larger being smooth and rounded, or subangular, and the smaller rough and angular. The beach material is chiefly made up of quartz, quartzite, vein-quartz, sandstone, flint, jasper, and shell fragments.

CECIL CARUS-WILSON.

April 21.

Gain of Definition obtained by Moving a Telescope.

THE phenomenon described by Mr. M. E. J. Gheury in NATURE of March 27, p. 86, is familiar to me in telescopic work.

Many years ago, when I used to sweep for comets, sometimes nebulæ would be seen to enter the field which were so faint that when the telescope came to rest they were only just discernible or invisible altogether. By slowly swinging the telescope back and forth they would become readily visible, as if the process of motion had the effect of greatly multiplying their light. This was not an unusual occurrence. I remember also that it made quite a difference as to whether the object entered from the right or left side of the field. It was easier to detect a very faint nebula or comet when it entered from a certain side. I cannot now remember whether this was from the right or left (the sweeps being horizontal), but I know

I used to take advantage of the fact and sweep so that the stars should enter from the favourable direction.

E. E. BARNARD.

Yerkes Observatory, Williams Bay, Wisconsin, U.S.A., April 15.

A Brilliant Meteor on April 23.

A MAGNIFICENT meteor was seen here by me at 9h. 8m. this evening. Starting from near β Leonis, the body travelled, nearly overhead, to near η Draconis. The head was yellowish and distinctly pear-shaped, pouring out behind it a shimmering tail of reddish material. The flight occupied some 5 sec. or more, for I had time to direct the attention of the Misses Baxandall—with whom I was talking—to it, and they then saw quite half the flight. The matter left behind was quite bright, tapering off for some 3°, and then quickly fading away. There was no sound and no violent disruption. The meteor, in flight, reminded me strongly of the photographs of Borrelly's comet published by the Lick observers in 1903. A marked feature was the leisurely flight and the appearance of matter being poured out from the receding head.

WILLIAM E. ROLSTON.

"Broadwater," Fulbrooke Road, Cambridge, April 23.

Spectacles for Use with Observing Instruments.

I DO not remember ever reading or seeing any article on how people who wear spectacles should look correctly through capped lenses of scientific instruments, such as telescopes, spectroscopes, microscopes, &c., nor what sort of spectacles weak-sighted people should use for that purpose, whether their long-sighted or reading spectacles, or whether special lenses should be obtained for that purpose. If the latter, a special form of lens cap might be made for the correct spectacle glass to fit into at the proper distance from the lens cap—when it is known what is the proper distance. At present this subject seems to be ignored, and it may be worth the attention of opticians to make rules and give hints or advice on the subject, so that people with deficient eyesight, especially the aged, may have more pleasure in their observations. Perhaps some of your readers may be able to give some useful hints as to what they find it best to do in the circumstances gained by many years of practical experience.

J. W. SCHOLES.

Grimscar, Huddersfield, April 21.

THE REPORT OF THE COMMISSION ON UNIVERSITY EDUCATION IN LONDON.

WHATEVER may be the ultimate result of the report of the Royal Commission on University Education in London, there can be no doubt that the Commissioners have performed, and performed admirably, a much-needed task. For success in any great enterprise it is essential that those who are engaged in it should have a clear mental vision of what they want. It need not be precise in detail, but it must be definite in outline.

The Commissioners have produced for the first time a faithful sketch of what the University of London may and should be. It is the conception of statesmen, and not merely of educationists interested chiefly in their own subjects, their own institutions or their own degrees. It is courageous, for the Commissioners do not hesitate to express their opinions even when they know that they must be opposed to sectional views and sectional interests. It is far-sighted, for it is linked with impending reforms in secondary education, and contemplates changes which are admitted to be temporary and preparatory only to further developments, such as the establishment of a south-eastern university outside the London area. It faces for the first time the question of the cost of a great metropolitan university. Whatever other purpose it may serve, it will for long be regarded as a self-consistent and well-conceived scheme which will serve as a standard with which other proposals must be compared. Those who object may at least be expected to state their objections in a specific form; to indicate whether those objections are to some general principle or to particular details; to make it clear what alternatives they suggest, and whether those alternatives would directly or indirectly modify the whole scheme, and, if not, how they can be incorporated into it.

In discussing the report in these pages it may be assumed that the readers of NATURE are generally acquainted with the past history of the University of London, and know that the development of the internal University under the constitution established thirteen years ago has been very great, but has been hampered by disunion in the Senate. Nor was that constitution framed so as to enable the Senate to deal with the difficult problems caused by the establishment of so strong and efficient an institution as the Imperial College.

Indeed, the whole question was raised, not only as to whether a new technological university should be established in London, but whether the Imperial College should not be regarded as a super-university institution to which other universities should be expected to send their best technical students, and which should gradually eliminate all teaching of undergraduates from its curriculum. With both these proposals the Commissioners deal very faithfully. For their arguments we must refer our readers to the report itself (sections 194–198). Suffice it to say that they sum up in the statement "that the analogy of the German Hochschule fails to support the claim for a technological university in England, and that the policy of establishing a super-university is neither a possible one nor to be desired on its merits."

But while thus decisively deciding on the main questions, the Commissioners have done much, indeed, it may be said, all that is possible, to secure both to the technical colleges and to the teachers of technology in general that freedom in educational matters the securing or retention of which was the main motive of those who feared the too complete absorption of the Imperial College in the University. The safeguards provided are described below. Turning from this point, which was largely the cause of the appointment of the Commission, we come to what logically precedes it, namely, the constitution proposed by the Commissioners for the University. It is chiefly on this point that the arrangements under which it has been working since 1900 have broken down.

The work of the University was then classed under two main heads, the internal and external sections respectively. The Senate consisted of fifty-six members, of whom thirty-two were equally divided between the graduates and the teachers, or practically between the external and internal sections, the remainder being chiefly representatives of learned and professional bodies. It is the opinion of the Commission that this scheme has not been successful, and that it has led to ambitions on the part of the external side of the University which, if fulfilled, would seriously hamper the development of a true teaching university in London.

The Commissioners, after describing the claims put forward in the report of the Council for external students, state that, "in our opinion it is these claims which, far more than anything else, form the real ground of the defective working of the University in so far as that is due to the present relations of the internal and external sides."

How far the External Council has departed from its true position is shown by the fact that it desires to be called the Imperial Council, while the present Academic Council is to be designated the Metropolitan Council, a title which implies, and is no doubt intended to imply, an inferior status. A house thus divided against itself cannot stand, and, as has been generally expected, the time has come for another drastic reform.

In outlining the measures necessary for this purpose the Commissioners propose to assimilate the constitution of the University of London to those of its northern sisters. In London, as in Manchester, the supreme legislative body will be a Court, consisting in London of about 200 persons, on which ample room can be found for all interests connected with the University.

The executive powers will be exercised by a small Senate, consisting of the Chancellor, Vice-Chancellor, and Chairman of Convocation, five persons appointed by the Crown, two by the Court, two each by the Academic Council and the London County Council, and one by the Corporation of the City of London.

Large powers of delegation are given both to the Court and the Senate, and, subject to the statutes and to the financial oversight of these bodies, the educational work of the University will be in the hands of faculties, the constitution of which differs in different cases, though in all the members will be wholly or in the main teachers of the University. These bodies are to have the power to determine generally the conditions for the award of degrees and diplomas, the courses of study, and the conduct of the examinations. They will present candidates for degrees and advise the Senate on the needs of the faculties. They are expressly prohibited from issuing detailed syllabuses, "for this is a matter for the professor, in consultation with his colleagues in the same branch of learning." They are to determine the respective parts played by written, oral, and practical examination, and by records of work, in the tests for the several University examinations, and to appoint the assessors who are to take part therein.

The rights of the teachers as a body and as individuals are therefore amply secured.

These privileges can, however, only be conferred if the standing of the professors is commensurately high, and the Commissioners accept provisionally the standard already practically set in the appointment of University professors.

An Academic Council will consist primarily of the deans of the faculties and of eight members elected by the faculties in common session. This Council may be regarded as exercising a coordinating influence on the faculties, as advisory to the Senate, but as capable of exercising such powers of the Senate as may be delegated to it.

Full privileges of separate examination will be enjoyed only by constituent colleges and departments which have either been established by the University or have consented to incorporation. The teachers in institutions which do not satisfy these conditions will practically have the same position as the schools of the University now occupy. Their teachers will be banded into boards which will lay down the courses of study and supervise the tests for degrees, &c., reporting to the Senate through the faculties. The system of the separate recognition of teachers in minor institutions will be abandoned, and the common or general examination, devised for the schools which are not constituent colleges of the University, will serve for the examination of external students, or, as they are to be called, unattached students, except in the cases of medicine and technology.

This is no hardship to external students. At present they are examined by specially appointed examiners who have in general no common experience, who need not necessarily be teachers, or may have ceased to be teachers.

They will now be examined by men necessarily and actually engaged in teaching. But these men will be drawn from a number of institutions, and the papers will only contain questions which they, acting in common with assessors, or, if the term is preferred, external examiners, think are fair to all their own students, however differently the students may be taught. The possible vagaries of one or two men will therefore be neutralised by the opinions of their colleagues and assessors. At present two "hanging judges" may affect the results. In future their influence will be tempered by more merciful colleagues, and the same scheme which prevents undue severity will also check a too exuberant leniency. The absence of detailed syllabuses will tend to defeat the crammers, but the fact that the papers are to be set to the students of the examiners themselves, and that those students are taught in various institutions, will check individual excursions outside the limits of a syllabus which the majority of unprejudiced experts would regard as fair.

The arrangements for technology are of a special character. The interests of that subject

will be entrusted to a committee of fifteen members, including the Vice-Chancellor, the rector of the Imperial College, and other members appointed as to a bare majority by the Senate, and as to the remainder by the governing body of the Imperial College. University and King's Colleges would each be represented by two of the appointees of the Senate, and three-fourths of the whole would consist of men of affairs and experts in the branches of technology dealt with. The income of the Imperial College and that available for the departments of engineering in University and King's Colleges would be at the disposal of this committee; and the annual budget of the committee would be submitted to the Senate, the governing body of the Imperial College, and the delegacies of King's and University Colleges.

Such, in very brief outline, and with many omissions, especially that of the important proposals with regard to medical education, is the scheme of the Commissioners, and they estimate that 99,000*l.* a year will be required to carry it into effect. They also consider that the headquarters of the University should be situate in Bloomsbury.

They have evidently done their best to meet the reasonable desires of all interests. The professors will have a freedom of teaching and testing their pupils which they have not enjoyed before. The internal students will be members of a more real and efficient teaching university. External candidates will probably have a better test than that to which they have been accustomed. These advantages must no doubt be purchased by some sacrifices in so far as they touch vested interests, but the whole scheme provides a much more satisfactory prospect both for internal and external students than that now in force.

RECENT HYDROGRAPHIC INVESTIGATIONS.[1]

IN the first of the publications referred to below, Dr. Rolf Witting gives an account of the hydrographic observations—sea-temperatures, salinities, oxygen-contents, current and ice observations—made in the Gulfs of Bothnia and Finland during the year 1911 by the Finnish hydrographers. The paper consists almost entirely of tables, and these are models of clear and orderly arrangement.

The second publication contains the hydrographic data collected during the voyage to Spitsbergen, in 1910, of the Norwegian ship *Farm*. The observations are discussed by Drs. Helland-Hansen and Nansen, and deal chiefly with the distribution of the Atlantic current in the sea to the west of Spitsbergen. A considerable part of the paper is taken up with a discussion of the errors of the hydrographers who had previously investigated the same area; but in addition to this the authors describe the gradual disappearance of the Atlantic current to the north-west of Spitsbergen, as this water becomes diluted by lighter arctic water flowing round the South Cape. There is a discussion of the parallelism in the annual variations in temperature of this Atlantic Spitsbergen current, and those of the Atlantic Norwegian stream. "Temperature anomalies" are compared—that is, the deviations, in each year, from the mean of a number of years. The variations in temperature of the Atlantic Spitsbergen stream are, then, roughly parallel to those of the Norwegian stream, *if the former are compared with the latter of two years' previous date.* That is, the water flowing to the north from the Faröe-Iceland channel takes about two years to travel from the latitude of 62° N. to that of about 78° N. The variations in temperature anomaly in the sea to the west of Spitsbergen are also parallel to the variations in the area of ice-free water in the Barentz Sea in May of the same year.

The third paper is of considerable interest and importance. After indulging in a polemic with reference to the erring Swedish hydrographers, Dr. Nansen considers the mode of origin of the cold water occupying the basins of the North Atlantic and Norwegian seas. These water-masses are very homogeneous. At the bottom of the Norwegian Sea there is a salinity which varies only between 34·90 per cent. and 34·92 per cent., and thus requires very careful investigation in order to disclose differences of a real nature. The submarine Faröe-Iceland ridge divides the northern ocean into two masses with respect to the temperature of the bottom water: at a depth of about 1000–2000 mètres the water on the Atlantic side of the ridge has a temperature of about $+2°$ C. to $+3°$ C.; on the Norwegian side the temperature of the sea-water at the same depth is about $-0·5°$ C. to $-0·8°$ C.

How does this cold and dense bottom water originate? It does not come from the southerly-flowing, cold polar currents, for this water is of low salinity, and in spite of its low temperature its density is less than that of the bottom Atlantic and Norwegian water, so that it cannot sink to near the sea-bottom. It does not proceed from melting ice, for water of such origin has also a very low salinity, and, notwithstanding its low temperature, its density is also low. The southerly-flowing polar currents, indeed, protect the underlying warmer water-masses from cooling, and melting ice has the same effect. In both cases the sea is covered with low-saline water which does not mix by convection with that beneath it. In order that a vertical circulation, accompanied by the formation of a cold bottom stratum of water, may occur, certain conditions are necessary:—(1) The water at the surface of the sea must not be in rapid horizontal movement; the best conditions are those in the centre of an area possessing a cyclonic circulation.

[1] (1) "Abhandlungen der finländischen hydrographischen-biologischen Untersuchungen." No. 10. Pp. 132+4 Taf. (Helsingfors, 1912.)
(2) "The Sea West of Spitzbergen. The Oceanographic Observations of the Isachsen Spitzbergen Expedition in 1910." Vidensk. Skrifter. I., Mat.-Naturv. Klasse, No. 12. Pp. 89+6 plates. (Christiania, 1912.)
(3) "Das Bodenwasser und die Abkühlung des Meeres." *Internat. Revue Ges. Hydrobiologie u. Hydrographie*, Bd. v., Heft i. Pp. 42+12 figs. in text. (Leipzig, 1912.)

(2) The surface water must be of approximately the same salinity as that of the sea bottom; if it has a much lower salinity, its density may not be increased by a reduction of temperature to an extent sufficient to set up convection movements reaching to the sea-bottom. (3) It must be cooled to a slightly lower temperature than that of the water at the sea-bottom, for its adiabatic contraction, by pressure, as it sinks must warm it slightly; this may be the cause of the slight increase in the temperature of oceanic water as we approach great depths—an increase which has been attributed to the emission of heat by radio-active substances in the oceanic bottom-deposits. (4) The *formation* of ice on the sea-surface may favour convection currents by raising the salinity of the superficial water; but this is not an important factor.

The cold bottom water of the North Atlantic Ocean originates in a restricted area of sea, outside the boundaries of the southerly-flowing polar current, and lying to the south-east of Greenland. Some of this water may also proceed from the surface of the Norwegian Sea after flowing over the Faröe-Iceland ridge.

Incidentally Dr. Nansen directs attention to the presence of Mediterranean water in the channel between Ireland and Rockall. This originates from warm and dense water flowing out as an intermediate current through the Straits of Gibraltar. The presence of this water in British seas was pointed out by Dickson in 1909 as the result of observations made in 1903 by Wolfenden. Dr. Nansen in 1909 referred to the methods of these observations as "so inaccurate as to be of little use." Nevertheless, he now adopts the conclusions drawn from them, without, however, referring to Dickson's prior discovery.

J. J.

SOUTH AFRICAN INSTITUTE FOR MEDICAL RESEARCH.

SOUTH AFRICA has decided to have an institute for medical research on the same lines as the Pasteur Institute in Paris, the Lister Institute of Preventive Medicine in London, or the Rockefeller Institute in New York. To this end a new building is now in process of erection in Johannesburg, and is expected to be complete in about twelve months.

A site has been provided by the Government, and we understand that the cost of building and equipping the new institute will be provided by the Witwatersrand Native Labour Association. The maintenance of the institution will be undertaken by the Government of South Africa and the association in equal shares.

A very satisfactory feature of the institute will be its close proximity to the largest hospital in South Africa, with which it is intended that it should work in conjunction. It will also be equipped with four wards for the purpose of treating patients, who will be the subject of special study.

From the present plans, the institute seems to be suitably arranged, and will be an imposing structure. It will comprise, in a main block, forming a two-storied quadrangle, the institute offices, experimental and observation hospital, animal house, mortuary, and director's house. Ample space is allowed here for future extension. Of this main block the northern and southern sides are prolonged eastwards and westwards to form two further quadrangles. These will contain the hospital wards and research laboratories, also library, museum, and further laboratories. The building will carry as well a lecture theatre, basement workshops and storage rooms, and a number of rooms for miscellaneous scientific purposes. A dome eighty feet in height will crown the building, and will carry a finial emblematic of the surrender by Death of his secret, and we understand that a second dome of equal magnitude is aspired to. Although we realise that an institute which is intended to render valuable service to the State should be housed in fashion suitable to the importance of the work it is to undertake, we sincerely hope that contemplation of the domes and the finial will not distract the attention of the authorities from the fact that the success of their scheme will essentially depend upon the *personnel* of the staff and the funds made available for scientific investigation.

The research work of the institute is, we understand, to be primarily directed towards the industrial diseases of the Transvaal, but all diseases will come under its scope. It is intended that research fellowships shall be available for medical men, in order that they may carry out special lines of investigation; also it is hoped that in the near future medical students will be enabled to undertake courses in pathology and bacteriology at the institute, of a character which can now only be attended in Europe.

Two appointments to the staff of the institute have already been made: the director of the institute will be Dr. Watkins Pitchford, and the statistician Dr. G. D. Maynard, both of whom have already accomplished sound work in connection with one or other of the public health organisations of the colonies now forming the Dominion of South Africa.

EDUCATION OF THE AUDITORY CENTRES.[1]

PROF. MARAGE, who is well known as an otologist and for his researches in physiological acoustics, has issued a small but suggestive pamphlet on what he terms the education of the auditory centres. It is known that there are cases in the clinique of the aurist where there is sensitiveness to even feeble noises while there is deafness to music and to speech. In others the patient may hear noises, music, and even speech sounds, but without any understanding of the meaning of the speech sounds. Prof. Marage

[1] "Education et Rééducation des Centres auditifs." By Prof. Marage. Pp. 15. (Paris, 19 Rue Cambon.)

explains these facts on the supposition that the cause is not to be sought in the mechanism of the ear alone, but in the relation of this mechanism to different parts of the brain.

The paths by which nervous impulses, generated by a sonorous vibration, say, in the cochlea, are communicated to the brain, are very complicated, and come into anatomical connection with many nervous centres. Such centres may be considered as being of higher and lower orders, and the nervous impulses may pass from lower to higher, calling forth at each stage a particular sensation—say, that of a noise or of musical sensations—until they reach the highest cerebral centres where there is the appreciation of all kinds of auditory sensations, such as noises, music, and speech.

Prof. Marage's method of stimulating the ear by his ingenious syren is well known. This instrument can transmit to the drumhead sonorous waves of a measured intensity (that is, the air-pressure is measured), and the special quality of each vowel tone is produced by sending the waves of pressure through resonators moulded on the form of the mouth and throat cavities for each vowel. Thus, by using the syren methodically, the ear may be stimulated by tones that, as regards both intensity and quality, are natural to it, instead of tones produced by tuning-forks, or noises, or by spoken words. Thus the ear and the nerve centres may be put through a course of education, a kind of drill, in short, produced by the syren. The results are said to be very encouraging with cases of whole or partial deaf-mutism.

Prof. Marage also gives in this pamphlet copies of tracings of vowel-forms produced by this syren which are well worthy of study, but he does not mention how these beautiful photographs were obtained. The gist of the whole matter is that in attempting to explain auditory mechanisms, we must not confine our attention to the ear alone, but to the ear as associated with auditory nerve centres. The investigation, in short, becomes more and more complicated.

JOHN G. MCKENDRICK.

NATURAL HISTORY IN CEYLON.

SPOLIA ZEYLANICA is an excellent quarterly publication designed to promote a knowledge of the natural history of Ceylon and its surrounding seas. It was established by Prof. A. Willey (now at Montreal) some eight or nine years ago when he was director of the Colombo Museum, and has been kept up since with admirable skill and energy by his successor, Dr. Joseph Pearson, the present editor. The part for January, 1913, contains, along with several notes on land and fresh-water animals, three articles of special interest on pearl-oyster fisheries.

The first article, by Captain Legge, "Master Attendant" at Colombo and inspector of the pearl banks, is semi-popular, and is written rather from the navigator's and the historian's point of view, containing notes and stories of fisheries and celebrated pearls. Here and there in Captain Legge's chatty account of his personal adventures on the pearl banks one comes on quite important observations, such as, when describing a walk in diving-dress over the sea-bottom:

> Immediately I walked off the "paar" I was upon very loose sand, in waves like giant furrows in a ploughed field; whilst for quite two feet high above the ground there was sand in suspension. Here oysters are covered up, buried and destroyed immediately.

Yet some recent writers have argued that there can be no movement of the sand on the bottom, and that beds of oysters cannot be silted up by moving sand.

Captain Legge gives us an additional instance of the now well-known danger to beds of oysters from predatory elasmobranch fish, as follows:

> At the inspection in November, 1902, I decided that a certain bed was quite the gem of those to be fished in March, 1903; the oysters were larger and older than any others I had inspected, and were very plentiful; however, as I was passing over this spot on my way back at the end of the inspection, I observed a very large shoal of rays in the vicinity. In the following March, about the second week of the fishery, I moved to this my pet bed of oysters, only, however, to be told by the divers that there were no living oysters there. I at once descended in the diving dress and found the bottom of the sea strewn with empty oyster shells, each valve turned nacre upwards and shining, giving a very curious effect, whilst each shell or valve was broken obviously by external pressure into three pieces. This could only have been done by the powerful jaws and teeth of the ray.

The second article is a well-considered, judicial account of the scientific work on the Ceylon pearl banks in the last decade, 1902 to 1912, by the editor, Dr. Pearson, director of the Colombo Museum and Government Marine Biologist. Dr. Pearson passes in review the scientific exploration of the pearl banks in 1902, the recommendations in Prof. Herdman's report to the Government, the formation of a financial syndicate in 1906 to take over a twenty years' lease of the fisheries at a large annual rental, their two highly profitable fisheries which cleared the ground of adult oysters, and then the subsequent failure of yield and resulting barren condition of the banks. The various operations suggested and performed are discussed, and the conclusion is reached that:

> The work subsequent to Herdman's reports gives very little evidence that his recommendations have been carried out seriously.

Dr. Pearson brings together a good deal of argument in favour of the possibility of oyster-beds being buried and lost by movements of the sand, and he quotes some personal observations, made on the bottom by the inspector of pearl banks, such as:

> What impressed me most was that the spots I dived on last March, which were then level rock, with a coating of 3 or 4 in. of sand, had now as much as a foot of sand in places. All over the sand was in fairly deep ridges, not so deep as the ridges of the

paar proper, but quite distinct from the appearance of the sea bottom last March.

The third "pearl-oyster" article, also by Dr. Pearson, is a report on the remarkable "window-pane oyster," *Placuna placenta*, in the great inland sea at Tamblegam, near Trincomalee; and other papers, by various authors, on fresh-water fishes, Oligochætes, Termites, &c., all show that the investigation of the natural history of Ceylon is in capable hands, and bids fair soon to make the fauna and flora of that charming island better known than those of most other parts of the eastern tropics.

NOTES.

As we went to press last week a case was concluded in the course of which the methods of anti-vivisectionists were again exposed. A Swedish lady, Miss Lind-af-Hageby, brought an action against *The Pall Mall Gazette* and Dr. Saleeby for alleged libel published in *The Pall Mall Gazette*. The jury, after listening to sixteen days of talking, gave their verdict for the defendants, and the judge received their verdict with most emphatic and outspoken approval. It has all happened before. There comes an opportunity for legal action: the statements of anti-vivisectionists are brought to the test of evidence on oath; the whole thing is thrashed out in the Law Courts, and the inevitable verdict is given. *The Pall Mall Gazette* has done a great service to the nation by thus exposing, once more, the uncharitableness—to say the least—of anti-vivisectionists. The Research Defence Society, likewise, deserves the thanks of lovers of truth. We trust that the public will bear in mind the lesson of this case, and will treat with contempt the methods upon which the obscurantism of anti-vivisection thrives. A campaign which appeals to those who have been least fortunate in the matter of education, inflames passion, stirs up hatred, and delights in imputing evil to men who are devoting their lives to the increase of knowledge of diseases which afflict mankind, may not be stopped on its downward course by the verdict given last week, but the light which was thrown upon it in the course of the evidence will perhaps do something to scatter the thick darkness of prejudice which anti-vivisection requires for its existence.

THE Bill to consolidate and amend the law relating to ancient monuments was read a second time last Thursday in the House of Lords. Such a measure must necessarily be tentative, and Earl Beauchamp admitted that it was not ideal. But he claimed justly that it was a considerable step for the object in view, while in no way penalising owners or interfering with the rights of property. The same difficulties occur as in other branches of the movement to make the country a decentralised museum, both of antiquities and of natural history and scenery. But there are also special difficulties in the case of ancient monuments. The Marquess of Salisbury pointed out that consideration would have to be given to the resident owner of a historic house. The question might arise as to whether he could be precluded from throwing two bedrooms into one. The case of cathedrals is peculiar, as Earl Curzon of Kedleston showed; they are not protected by a faculty, as churches are, but are the absolute property for the time being of the dean and chapter. Earl Beauchamp had not seen his way to include ecclesiastical buildings, but it appears that the bishops would not object to the inclusion of cathedrals. The power of purchase by the State is eliminated from the Bill; full powers for a Preservation Order are considered to render this unnecessary. The power of purchase is given to the local authorities, chiefly in view of the smaller monuments of local interest. Here comes in the difficulty of funds; even for small purchases there must be an increase of the rates. Meanwhile the larger monuments seem to be unprotected. There is no doubt that owners of great historic heirlooms do treat them as in trust for the nation. But the modern tendency is to bring this spirit into the machinery of organisation. The passing of such a Bill may be expected to react favourably on the connected questions of nature reserves and the endowment of science.

THE relation between insect-eating birds and the abundance or otherwise of insects, ticks, and other creatures which may act as hosts for organisms associated with various diseases, is known to every biologist. A correspondence between Sir Harry Johnston and the chairman and secretary of the Plumage Committee and Textile Trade Section of the London Chamber of Commerce, published in *The Times* of Tuesday, April 29, deals with some points of this relationship, with particular reference to tsetse-flies, mosquitoes, and other blood-sucking insects of Africa. Sir Harry Johnston points out that tsetse-flies of the genus Glossina are particularly abundant in all those parts of West and Central Africa where the plumage trade has done so much to lessen the numbers of the insect-eating birds—more especially white herons (egrets, large and small), ibises, rollers, bee-eaters, glossy starlings, drongo and "cuckoo" shrikes, bishopfinches, and kingfishers. As remedial measures to prevent the disturbance of the balance of nature caused by the destruction of these birds, he suggests "that the secretary to the British Museum (Natural History) or the secretary to the Zoological Society, or perhaps the two jointly, should be asked to compile a list of species, genera, and perhaps families of birds which should be placed on the prohibited list. That is to say, that the skins or other trophies of such birds should be forbidden as an article of import into Great Britain and Ireland and into all parts of the Empire of which the fiscal affairs are influenced by the Foreign and Colonial Offices; and that we should use our best endeavours with the Governments of the self-governing portions of the British Empire to secure a like prohibition in their own Customs regulations."

IN a letter to the Lord Mayor, the Prime Minister has announced the extent of the provision which the Government proposes to make for the dependents of Captain Scott and of those who so heroically lost their lives with him in the Antarctic. The Government intends to ask Parliament to sanction a Special

Vote sufficient to provide as follows:—For Lady Scott (in addition to the Admiralty pension of 200*l.* per annum for herself and 25*l.* per annum for her son, until he reaches the age of eighteen) an annuity of 100*l.* For Mrs. Scott, the mother, and Mrs. Campbell and Miss Grace Scott, the sisters, of Captain Scott, a joint annuity of 300*l.* For Mrs. Wilson, the widow, and Miss Mary Souper, the sister-in-law, of Dr. E. A. Wilson, a joint annuity of 300*l.* For Mrs. Evans, the widow of Petty Officer E. Evans (in addition to the pension and allowances awarded to her by the Admiralty, amounting to 13*s.* 6*d.* a week), a further annuity of 12*s.* 6*d.* a week for herself and 3*s.* a week in respect of each of her children up to the age of eighteen. The Government of India, in the service of which Lieutenant Bowers was before joining the expedition, has offered to provide pensions, amounting in all to 100l. per annum, for his mother and sisters. Captain Oates, the fifth member of Captain Scott's southern party, was unmarried; and as no mention is made of any relatives, it may be assumed that he was possessed of ample means. In addition to the provision referred to above, the total amount subscribed by the public as a memorial for the dead explorers and kindred purposes is 55,760*l.*

ON Monday last Sir Clements Markham, at the meeting of the Royal Geographical Society, gave a paper on Vasco Nuñez de Balboa, in commemoration of the fourth centenary of the discovery of the Pacific Ocean in 1513. The anniversary actually falls in September. The author did full justice to the discoverer's strength and many other excellences of character, which stand out in contrast with the majority of his compeers in the same field; the question, often asked, was repeated, What would the history of western South America and its highly civilised native races have been if Nuñez and others such as he had been allowed the chance to establish friendly relations with them and assimilate their ideals with those of Europe, instead of their suffering the extreme penalty of extermination? Two noteworthy efforts of geographical theorising were discussed as following upon Nuñez's discovery. The first was the well-known and successful endeavour of Magellan to turn the flank of the South American barrier, and to sail his vessel directly from the Atlantic into the Pacific. The second, less familiar, was the brilliant reasoning by which Andres de Urdaneta, in 1565, succeeded in piloting a return voyage across the Pacific from west to east, for the first time, by following a northerly course, on which were found favourable winds, the reverse of those which prevailed on the more southerly course followed by the earlier navigators across the ocean from east to west. Reference was made to the work still awaiting trained explorers in the very area of Nuñez's crossing of the isthmus of Darien.

WE are glad to learn from the annual statement on the work of the Post Office, made in the House of Commons on April 24 by the Postmaster-General, that it is proposed to establish a new service for the synchronising of clocks. For a small fee per annum the Post Office will send every day an hourly time signal. Any institution, business house, or industrial establishment to which it is important to have the correct time and which is willing to provide the internal apparatus for the clocks can obtain for a small fee an hourly time service. The fee may vary with the distance, but if there are a sufficient number of subscribers it will be about £2 a year. The Greenwich time signal will be transmitted once daily over telegraph circuits for the regulation of master clocks fixed at suitable "distributing centres" at head or branch post offices, and these master clocks will transmit hourly impulses to the premises of persons requiring the service. The Post Office will provide and maintain the distributing wire up to a suitable point at the renter's premises, but it will rest with the renter at his own expense to fix and maintain to the satisfaction of the Post Office all other wiring within his premises, as well as the clock and the synchronising mechanism. The arrangement will be confined for the present to the central districts of large towns. It will be recalled that the British Science Guild has taken a leading part in directing attention to the importance of synchronising all clocks publicly exhibited. In the fifth annual report of the guild a committee appointed to deal with the subject described the position of the subject at home and in some other countries, and stated the results of representations made to the Post Office, the London County Council, the Corporation of London, and other authorities. The hope was expressed by the committee that the Post Office would before long be in a position to offer facilities to the public for the synchronisation of clocks at such rental rates as should remove the main objections which have been urged to the general adoption of the principle. The announcement now made by Mr. Samuel seems to represent the realisation of this desire.

THE first conversazione of the Royal Society for this year will be held in the rooms of the society at Burlington House on Wednesday, May 7.

THE death is announced, on April 25, of Prof. J. Park, professor of logic and metaphysics in the Queen's University (formerly Queen's College), Belfast, since 1868.

THE Berlin correspondent of *The Times* announces that Prof. Fritz von Bramann, professor of Halle University, and director of the surgical laboratory there, died on April 26, at fifty-eight years of age.

WE learn from the *Revue Scientifique* that the teachers of the Normal School at Avignon, of which M. J. H. Fabre, the entomologist, was a pupil, are taking steps to raise a fund with the view of erecting a monument to "The Insects' Homer." The general council of Vaucluse has voted 1500 francs to the fund.

ON Saturday, May 10, Mr. H. A. Humphrey will begin a course of two lectures at the Royal Institution on Humphrey internal-combustion pumps. The Friday evening discourse on May 9 will be delivered by Mr. F. Balfour Browne on the life-history of a water-beetle, and on May 16 by Captain Cecil G. Rawling on the Pygmies of New Guinea.

THE Geologists' Association has arranged a Whitsuntide excursion to Nottingham, from May 9 to May

14. The directors are Prof. J. W. Carr, Prof. H. H. Swinnerton, Mr. G. W. Lamplugh, and Rev. E. H. Mullins. The party will travel *viâ* Great Central Railway on Friday, May 9, by the train leaving Marylebone Station at 4.45 p.m., and due at Victoria Station, Nottingham, at 7.37 p.m.

DR. ALEXANDER SMITH, professor of chemistry at Columbia University, New York, has accepted election to the chair of that subject at Princeton. Prof. Smith is a Scotsman by birth, and graduated in science at Edinburgh University, where he was for a short time an assistant in chemistry. He went to America in 1890, and held professorships successively at Wabash College and the University of Chicago before his appointment to Columbia.

IN our issue of December 19, 1912, Prof. Milne announced that Mr. Shinobu Hirota had been compelled by ill health to return to his native country, Japan. We regret now to learn that Mr. Hirota died on April 24. During the eighteen years he lived in England as assistant to Prof. Milne, he played an active part in establishing a new branch of geophysics, and had he recovered he might well have continued in Japan the work to which he was devoted.

AT an extraordinary general meeting of the University of Durham Philosophical Society, to be held in the Physical Lecture Theatre, Armstrong College, Newcastle-on-Tyne, to-morrow, May 2, Sir J. Alfred Ewing, K.C.B., F.R.S., will deliver a lecture on the structure of metals. The occasion is the first meeting to be presided over by the Duke of Northumberland, and has been arranged in connection with his installation as Chancellor on the following day.

THE council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1912-13:—A Telford gold medal to Mr. Murdoch Macdonald, C.M.G. (Cairo); a George Stephenson gold medal to Mr. G. D. Snyder (New York); a Watt gold medal to Mr. H. A. Humphrey (London); Telford premiums to Messrs. C. W. Methven (Durban), B. Hall Blyth, jun. (Edinburgh), C. J. Crofts (Durban), Frank Grove (Canton), B. T. B. Boothby (Hankow), and Francis Carnegie (Enfield Lock), and the Manby premium to Capt. C. E. P. Sankey, R.E. (London).

THE French aviator, M. Gilbert, on April 25 covered a distance of some 512 miles, from near Paris to Vittoria, in northern Spain, on a biplane, in 8 hours 23 minutes, without once alighting. He is reported to have travelled from Paris to Bordeaux at a speed averaging seventy-four miles an hour. Between Bordeaux and Biarritz he flew at a height of nearly 10,000 ft. Starting again after two hours' rest, he added another 155 miles to his flight, arriving at Medina del Campo, thus covering, in less than eleven hours, 668 miles.

A DISTINGUISHED committee has been formed, with the King of Italy as president, to obtain funds by public subscription for the institution of suitable memorials of the late Prof. Giovanni Schiaparelli, whose work for astronomical science is of the first rank of importance. It is proposed to erect to his memory a monument at Savigliano, his birthplace, and to place a tablet bearing his effigy in the Brera Palace at Milan, where he described his observations and conclusions. Among the members of the honorary committee are the presidents of the chief scientific societies in Italy, rectors of the universities, and directors of astronomical observatories. The president of the executive committee is M. Gullino, the Syndic of Savigliano (Cuneo), to whom subscriptions should be sent.

THE executive committee of the British Science Guild has issued a report on the Milk and Dairies Bill and on further legislation desirable on the subject. While expressing general approval with the Bill as a whole, the committee fears that its largely permissive character will allow local authorities to ignore the powers conferred upon them. It considers that the medical officer of health is placed in a difficult position by having to criticise, and possibly to be instrumental in instituting legal proceedings against, those who appoint him, who may have the power to terminate his appointment. The committee also regards the provisions as inadequate to check the supply of tuberculous milk. Comment is made on bovine tuberculosis and the means for stamping it out, and the opinion is expressed that the Bill grapples with the evil of bovine tuberculosis only in its fully developed form, and not with the less manifest or latent forms of the disease, which it is equally, or even more, important should be dealt with.

WE are informed that the Crocker Land expedition, which was postponed for a year on account of the death of Mr. George Borup, has been completely reorganised during the past year, and that the plan now is to send it northward in July next. The object of the expedition is the scientific exploration of the land supposed to lie north-west of the line of islands stretching from Grant Land to Prince Patrick Land. In addition to the mapping of the new land and of the uncharted coast lines in the vicinity of Grant Land and Axel Heiberg Land, the party will carry on studies during a period of more than two years in many other branches of science, including meteorology, terrestrial magnetism, wireless telegraphy, seismology, geology, zoology (both vertebrate and invertebrate), botany, ethnology, and archæology. The *personnel* of the expedition is as follows:—Mr. Donald B. Macmillan, leader of the expedition; Ensign Fitzhugh Green, U.S. Navy, map work, electrical work, terrestrial magnetism, and seismology; Mr. W. Elmer Ekblaw, geologist and ornithologist; Mr. M. C. Tanquary, zoologist, with particular reference to invertebrate zoology.

IN addition to the appropriation for defraying the expenses of the current work and operations of the department of terrestrial magnetism, the trustees of the Carnegie Institution of Washington, at its annual meeting last December, set aside one hundred thousand dollars for the purchase of a site and erection of a building for the department. After an inspection of various sites, one embracing about seven acres, situated in the district of Columbia, near Rock

Creek Park, was finally found suited for the purpose, and has now been purchased. The building will be about 52 by 101 ft., and will consist of two stories and a basement. It will contain adequate facilities for office, laboratory work, and instrument shop, and will be ready for occupation early in 1914. The magnetic survey yacht *Carnegie* left St. Helena on April 9 bound for Bahia, and is expected to return to her home port at the end of the year, thus completing the three years' circumnavigation cruise begun in June, 1910. After leaving Bahia she will once more call at St. Helena, and proceed next to Falmouth, where she is due early in September. It will be recalled that the *Carnegie* made Falmouth one of her chief ports on the cruise of 1909.

ONE of the most beautiful objects in western England is the famous screen in Banwell Church, about seventeen miles south-west of Bristol, in co. Somerset. Among the most treasured possessions of the parish is a record of churchwardens' accounts between 1515 and 1602, which give full particulars of the cost of the screen and of the workmen engaged upon it. These have been abstracted, with good illustrations of this fine piece of woodwork, by the vicar, Rev. C. S. Taylor, in part i., vol. xxxv., of the Transactions of the Bristol and Gloucestershire Archæological Society for 1912.

NIGERIA presents a promising and almost unworked field for the collection of folk-tales. Major A. J. N. Tremearne, in his recently published "Hausa Superstitions and Customs," has issued a large number of tales. From Southern Nigeria Mr. E. Dayrell, District Commissioner, in continuation of his "Folk Stories from Southern Nigeria," published in 1910, has now published, through the Royal Anthropological Institute, a series of Ikom folk-stories. These are of much ethnological interest, as they throw much light on matrimonial customs, of which female circumcision forms part. He also deals with human sacrifice and the Ju-ju form of sorcery, on which our information is still incomplete. "The more," he says, "one learns about Ju-ju the more hopeless it seems. It must seem incredible to people at home that a man can die because a Ju-ju has been made against him—for example, two sticks crossed on the path with, say, a rotten egg and a fowl stuck on a stick, the man's name having been 'called.' And yet one knows of numerous instances where men have died, and young, healthy men, too, against whom such a Ju-ju has been made." Parallel instances from Australia at once suggest themselves. Mr. Dayrell thinks it possible, in such cases, that poison may have been administered, but it is most difficult to get any proof.

THE power of the body to adapt itself to its needs is one of the most familiar of physiological truths. It has long been known that among the organs the heart shows ready adaptability. This is very strikingly illustrated by numerous measurements recently published by Dr. Grober, of Jena (*Naturwissenschaftliche Wochenschrift*, April 6 and 13). The figures refer to men in different employments, and to various animals with varying activities. The most remarkable fact (the explanation of which is not clear) recorded is that the right side of the heart usually increases in bulk more than the left side does.

The British Review for April contains an interesting article, entitled "Colour-hearing," in the form of a dialogue between the writer ("C. C. Martindale"), an "exceedingly eminent specialist" ("the Doctor"), a lady ("Mrs. X."), a scoffer ("the Metaphysician"), and "N. K.," who is able to "hear colour" (or, more accurately, to "see sounds"). No one acquainted with the characteristics of synæsthesia can doubt that it is a substantially accurate account of a conversation that took place. Indeed, the anonymity of "the Doctor" and "Mrs. X." is but thinly veiled. The article is hence of value to those interested in the study of this attractive but obscure subject.

THE Adamson lecture for 1913, delivered by Prof. Bernard Bosanquet, in the University of Manchester, entitled "The Distinction between Mind and its Objects," consists in a brilliantly critical examination of the claims of Modern Realism—a twentieth-century philosophical school of thought, "which, whether unsatisfactory or not, is definitely new." Prof. Bosanquet reaches the conclusion that neither Realism nor its antagonist, Mentalism, is satisfactory *per se*. "What special use or gain," he asks, "is there in saying that knowledge is physical, when you have to subjoin an elaborate explanation admitting into this physical reality all the ignorance, errors, and illusions that the feeblest or most fantastic of minds could be guilty of? Or what gain for mentalism is there in treating knowledge as a part of your mind, when you must say in the same breath that it is only knowledge in virtue of the reality that appears in it? The double nature of knowledge, as the continuity of mind and reality, is the ultimate truth to insist on."

Two very interesting lectures on the present position of the sex-determination problem, by Profs. Correns and Goldschmidt, have been published by Borntraeger (Berlin), under the title "Die Vererbung und Bestimmung des Geschlechts" (pp. 149, price 4.50 marks). Prof. Correns deals with the subject largely from the botanical side, but devotes ten pages to the case of *Abraxas grossulariata*, and has numerous shorter references to other experiments with animals. Prof. Goldschmidt devotes the greater part of his section to an account of the cytological side of the subject. One of the difficulties in the study of this question has hitherto been that observations and experiments on the zoological and botanical side have been published largely in different periodicals, so that the worker on one side has been in some danger of overlooking results obtained on the other. For the zoological investigator, therefore, Prof. Correns's summary of our present knowledge of the phenomena of sex in plants is of great value. Prof. Goldschmidt gives a carefully chosen and lucid account of "sex-chromosomes," but the most valuable part of his section is probably the demonstration that there is no discordance between the cytological and experimental investigations; they are, in fact, complementary, and each confirms and amplifies the other. Both lectures are illustrated with excellent diagrams.

ACCORDING to the April number of *Museum News*, the Brooklyn Museum has installed an antarctic exhibition. On the walls of the alcove in which it is displayed are hung a map of the south polar region and prints illustrative of antarctic life. Among the specimens are a group of king-penguins, a young sea-elephant, various petrels (including the miscalled Cape pigeon), an albatross, and a black-footed penguin.

FROM the report for 1912 we learn that the Zoological Society has had, on the whole, a successful and prosperous year, the number of fellows being the highest on record, while, despite the enhanced cost of provisions, the income shows a healthy excess over normal expenditure. During the year the president and council have directed their attention to the subject of zoological nomenclature, and have expressed the opinion that "an absolutely invariable application of the rule of priority . . . is not to the advantage of zoological science, and that they would welcome a modification of it, as, for instance, by the establishment of an authoritative fiat list of reserved names." The compilation of such a list formed, we believe, a part of the deliberations at the recent Zoological Congress at Monaco. Reference is made to the loss of the valuable services of the society's librarian, Mr. F. H. Waterhouse, who retired on a well-earned pension after forty years' work.

THE annual report of the Norwich Castle Museum for 1912 records a decrease in the number of visitors on the previous year, due to the disastrous floods following on the unprecedented rainstorm in Norfolk on August 26 last, when the city of Norwich was practically isolated from the rest of the country. The success of the attempt to stimulate public interest, benefit the studious, and give point and purpose to the collections has again been evidenced by the large and appreciative audiences at the lantern lectures and demonstrations given at the museum under the auspices of the Norwich Museum Association. The subjects of lectures during the year 1912, to which a limited number of the general public were admitted free, were:—Food fishes, Prof. Garstang; poultry, Mr. Edward Brown; old-time methods of lighting, Mr. L. G. Bolingbroke; artistic glasswork, Mr. R. F. Martin; winged insects and their larvæ, Prof. F. V. Theobald; wild flowers and photography, Mr. H. E. Corke; and African big-game, Miss Cara G. Buxton. During the summer months a weekly exhibit of living specimens illustrative of nature-study was carried out by members of the association. A pleasing feature of the year is the interest evinced in the museum collections by the pupils from the council schools, 151 visits being arranged by the organiser of elementary education and 4789 pupils recorded.

VOL. xxxii. of the Observations made at the Royal Magnetical and Meteorological Observatory at Batavia refers to the year 1909. The preface, however, by the director, Dr. W. van Bemmelen, brings the history of the observatory down to 1912. It mentions the recent establishment of several mountain meteorological stations. Upper air and seismological observations have recently received considerable attention at Batavia, but are dealt with in different publications. The present volume comprises meteorology and terrestrial magnetism. Like previous volumes of the series, it contains numerous tables of meteorological data for the year. On p. 110 there is a summary of mean values based on from twenty-one to forty-six years. The annual variation of rainfall is unusually regular and marked, the monthly amount varying from 38 mm. in August to 332 mm. in January. As befits a station only 6° 11′ south of the equator, the annual variation of temperature is exceedingly small, the mean temperatures of the warmest and coldest months differing by only 1·04° C.

FOR some years magnetographs have been run at Buitenzorg, an electrically undisturbed station some twenty-five miles south of Batavia. There are two sets, one by Adie and a recent set by Töpfer and Schultze. Both sets record vertical force, but while the Adie set records as usual declination and horizontal force, the other set records the N.-S. and E.-W. components, and hourly values are given of these components in vol. xxxii. of the Observations made at the Royal Magnetical and Meteorological Observatory at Batavia. Declination at Buitenzorg is less than 1°, so that the diurnal variation of the horizontal force and its N.-S. component are almost identical, and the same is true of declination and the E.-W. component when the former is expressed in terms of force. Thus the departure from the ordinary procedure is more apparent than real. The introduction states that the magnetic character data for individual days are based entirely on the horizontal force, as being much the most disturbed element. The effects of magnetic storms are very readily traced in curves at the end of the volume showing the variation from day to day throughout the entire year in the absolute values of the several elements.

THE *Verhandlungen* of the German Physical Society for March 30 contains a communication made to the society on March 14 by Dr. E. Grüneisen, on the effects of temperature and pressure on the electrical resistivities of pure metals. He finds on examination of the results for the resistivities of copper, silver, platinum, gold, and lead down to very low temperatures that for each of them the resistivity varies as the product of the absolute temperature and the atomic heat at constant volume. Assuming Wien's law that the number of impacts between electrons in the metal and metal atoms is proportional to the square of the amplitude of oscillation of the atoms, he deduces that the resistivity of a metal at constant temperature should decrease as the pressure is increased, at a rate which is of the same order as that found experimentally by Williams, Beckmann and others. Alloys the resistivities of which can be calculated correctly by the law of mixtures from the resistivities of their constituents follow the same law.

IN the course of his address as president of the Institution of Mechanical Engineers, Sir H. F. Donaldson referred, among other matters, to the

value of systematic research in engineering works. For example, in the heat treatment of steel, no amount of rule-of-thumb or the possession of an expert eye could ever ensure uniformity in results which vary enormously with but slight alterations in temperature; some system of pyrometry is called for as a protection against failures. The president suggests the establishment of an engineering research committee with a view to coordinate the work, to prevent overlapping, to ensure the carrying out of individual researches to absolute results, and to publish such results. In time the committee would acquire so large an accumulation of data as to make it the first source upon which the public would draw for information as to any research already effected, and as to the possibilities of extending research on lines which might seem to require investigation. The success which has attended the engineering standards committee might be regarded as holding out possibilities of success for an engineering research committee.

THE Cambridge University Press will publish shortly a book on "Rubber and Rubber Planting," by Dr. R. H. Lock, dealing with the history of the use and cultivation of rubber, its botanical sources, the botanical physiology of rubber and latex, the diseases, chemistry, and manufacture of rubber, and with rubber planting.

THE April edition of the catalogue of second-hand scientific instruments which are for sale or hire at the establishment of Mr. Charles Baker, 244 High Holborn, London, W.C., has reached us. The list includes some 2000 items, and an examination of the catalogue shows that customers can obtain second-hand practically every class of scientific instrument. Every instrument in the second-hand department is guaranteed to be in adjustment.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR MAY:—

- May 1. 20h. 24m. Mars in conjunction with the Moon (Mars 0° 48′ S.).
- 4. 12h. 0m. Venus in conjunction with the Moon (Venus 1° 26′ N.).
- 5. 9h. 0m. Jupiter stationary.
- 7. 10h. 35m. Saturn in conjunction with the Moon (Saturn 6° 20′ S.).
- 10. 21h. 19m. Neptune in conjunction with the Moon (Neptune 5° 21′ S.).
- 12. 9h. 0m. Uranus stationary.
- 13. 17h. 0m. Venus stationary.
- 18. 3h. 0m. Mars in perihelion.
- 23. 10h. 23m. Jupiter in conjunction with the Moon (Jupiter 4° 56′ N.).
- 25. 0h. 50m. Uranus in conjunction with the Moon (Uranus 3° 38′ N.).
- 29. 1h. 0m. Saturn in conjunction with the Sun.
- 30. 15h. 0m. Venus at greatest brilliancy.
- 31. 2h. 25m. Mars in conjunction with the Moon (Mars 3° 9′ S.).
- 31. 6h. 31m. Mercury in conjunction with Saturn (Mercury 2° 4′ N.).

THE SUN'S POLAR AND EQUATORIAL DIAMETERS.—The *Annales de l'Observatoire Astronomique de Lô-sè* (China), tome vi., contains three parts, the second of which is devoted to an account of a photographic study of the polar and equatorial diameters of the sun as deduced from observations made during the period of 1905–10. The investigation was carried out by Le R. P. S. Chevalier, S.J., and had for its first object the discovery, if possible, of variations in the mean diameter of the sun. The results obtained may be briefly summarised as follows:—There is a difference between the polar and equatorial diameter, the former diameter being the greater of the two. This difference does not seem to be constant, and the variations indicated cannot, according to the author, be attributed to errors of observation, and, so far as he can see, must be due to the sun itself. Here are the values for each of the six years:—

Year		Pol.-Equat.
1905	...	+0·07″
1906	...	+0·17″
1907	...	+0·31″
1908	...	+0·29″
1909	...	+0·13″
1910	...	+0·17″
lean	...	+0·19″ ± 0·015″.

With regard to the value of the mean diameter, he obtains 31′ 59·93″, which differs somewhat from that usually adopted, namely 31′ 59·26″, on the authority of Dr. Auwers, after a series of measures with the heliometer. While Chevalier points out that there is evidently a systematic error in one of the two sets of measures, and it may be in the photographic series, but he has not been able to trace it, yet, he asks, is it quite certain that it is excluded from the heliometric series, these measures all being made with instruments of the same type and short focal lengths?

UNITED STATES NAVAL OBSERVATORY.—We have received a copy of the annual report of the Naval Observatory for the fiscal year 1912. This modest and admirably concise account of the year's work of three active and important departments, corresponding to our Greenwich and Kew observatories and the Nautical Almanac Office, merely forms appendix No. 2 to the annual report of the chief of the Bureau of Navigation. The department of the Nautical Almanac, under the direction of Prof. W. S. Eichelberger, U.S. Navy, who represented the observatory at the Congrès International des Ephémérides Astronomiques, held at Paris in 1911, has expressed, under authority of the U.S. Congress, its willingness to adopt the programme of exchanges of data recommended at the Paris meeting. Particulars are given of various significant changes it is proposed to make in the American Ephemeris and Nautical Almanac, beginning with the edition of 1916. Considerable progress appears to have been made in the adoption of the Sperry gyro-compass in the U.S. Navy; six battleships and two submarines are supplied with sets, and ten additional sets have been ordered. The ordinary magnetic compass is still retained in ships fitted with gyro-compasses. We are informed that the noon signal has been transmitted by radio-telegraphy to ships at sea since so long ago as January, 1905. Special attention is being devoted to making improvements in the instruments of nautical astronomy. Among a long list of novel apparatus we note that a gyroscopic artificial horizon has been tried.

DISTRIBUTION OF SPECTROSCOPIC DOUBLE STARS.—In the April number of *L'Astronomie*, Prof. P. Stroobant, of the Observatoire Royal de Belgique, using Campbell's second catalogue of spectroscopic binary stars, published in 1910, shows that representatives of this class of stars are most abundant in the neighbourhood of the Milky Way—a similar result to that already found by E. Zinner for variables of the Algol type, to which the spectroscopic doubles bear a strong analogy. Stroobant shows that in this condensation the stars in question obey the law of distribution found by Pickering for the helium stars, being almost precisely proportional to the number of class B stars amongst the binaries.

JADE IN CHINESE SECULAR LIFE AND RELIGION.[1]

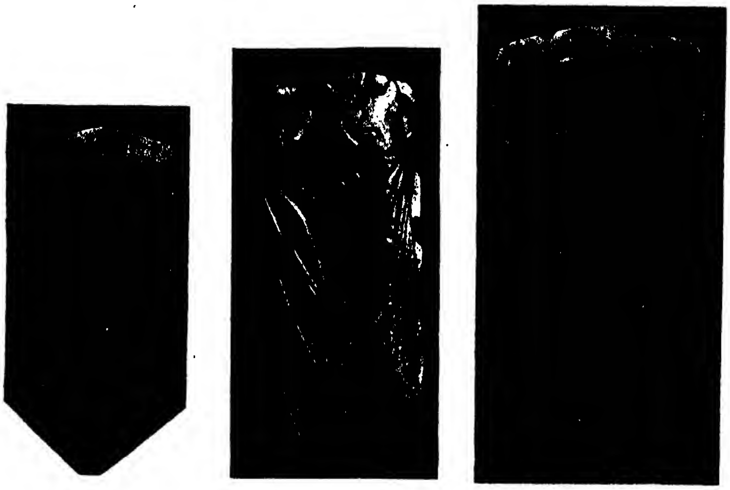
THE sumptuous monograph on the Bishop collection in New York entitled "Investigations and Studies in Jade" is so rare as to be inaccessible, and consequently there is room for another work on the subject. The authorities of the Field Museum of Natural History of Chicago were well advised to entrust the Blackstone expedition to Tibet and China to Dr. B. Laufer, and to encourage him to describe the jade objects he collected in a comprehensive monograph. As a matter of fact, his specimens largely supplement, and only slightly duplicate, the wonderful collection in New York, as most of them were exhumed from ancient graves, whereas the majority of the specimens in the Bishop collection are modern. Similarly, his monograph supplements the other; he does "not deal with jade for its own sake, but as a means to a certain end; it merely forms the background, the leading motive, for the exposition of some fundamental ideas of Chinese religious concepts which find their most characteristic expression and illustration in objects of jade."

The oldest Chinese term for jade is just as general and comprehensive as our word, and includes nephrite, jadeite, bowenite, and occasionally serpentine, &c.; at present only the first two are acknowledged as true jade by the Chinese. The jades of the Chou and Han dynasties are made of indigenous material from the Shensi province, but the supply was exhausted long ago, and about the beginning of the Christian era Turkestan became the chief source for the supply of jade to China, Yünnan and Burma also contributing later. The importance of the trade in jade can be realised when one remembers that "for the last two millenniums Turkestan has furnished to China the greater supply of her jade, wrought and unwrought, and the most colossal boulders of the mineral were constantly transported from Khotan to Si-ngan-fu and Peking, over a trade route unparalleled in extent and arduousness in Europe, and requiring a four to six months' journey."

In dealing with stone implements, Dr. Laufer points out that none of Palæolithic type have as yet been found; all are polished, they are found scattered in certain parts of the country, and are generally scarce. In the present state of our knowledge it is not justifiable to speak of a Stone age in China, and still less of a Stone age of the Chinese, since at the time when they were settling and spreading they were already in possession of metal implements. Four centuries ago Chinese antiquaries spoke of "thunder-axes," and in the eighth century they were described as "stones of the God of Thunder"; sometimes they were made of jade.

The ancient spade-shaped stone implements of the Kolarian-Mon peoples were reproduced in jade and bronze in the Han period, but in the earlier Chou period there was a bronze currency of similar shape. The first sovereign of the Han dynasty (B.C. 206–195) announced his accession to the throne by sacrificing to heaven an engraved jade tablet, a custom which continued for a thousand years or so; these writing tablets were developed from the ancient bamboo slips or wooden splints which served as writing material before the invention of paper.

There is a correlation between the jade objects used in nature-worship and those buried in the graves of the Chou era. Heaven, earth, and the four quarters were six cosmic powers or deities, and the jade carvings serving their worship were nothing but the real images of these deities under which they were worshipped. Anthropomorphic conceptions are lacking in the oldest notions of Chinese religion, and therefore no anthropomorphic images are known. The shapes of these images are geometric in design: a jade disk, round and perforated, representing heaven, a tube surrounded by a cube earth, a semicircular disk the north, &c.



a *b* *c*

FIG. 1.—*a*, Plain type of tongue-amulet; *b*, tongue-amulet carved in shape of realistic cicada—upper face; *c*, tongue-amulet showing conventionalised form of cicada. From "Jade: A Study in Chinese Archæology and Religion."

In addition to the use of jade in religious worship its employment in coins, seals, and personal ornaments is fully dealt with, and a very interesting account is given of the various kinds of jade amulets for the dead, other objects being buried besides these. The belief prevailed that jade had the property of preserving the flesh of the body and keeping it from decay, and it was also believed that immortality could be obtained by eating from bowls made of a marvellous kind of jade called "the perfection of jade." Among the amulets worn by the corpse, those placed on the tongue were the most important, and were shaped in the outline of that organ; many are in the form of a cicada, doubtless as an emblem of resurrection; indeed, the

[1] Field Museum of Natural History, Anthropological Series, Publication 154. "Jade: A Study in Chinese Archæology and Religion." By B. Laufer. Pp. xiv+370+68 plates. (Chicago, 1912.)

philosopher Wang Ch'ung said, "The vital spirit of a dead man leaving the body may be compared to the cicada emerging from the chrysalis." There were also eye, lip, and umbilical amulets.

Dr. Laufer has a very extensive knowledge of Chinese literature and of folk-usage and beliefs, and as he has discussed the matters studied with Chinese savants, we have a remarkably complete and discerning monograph, which will appeal alike to connoisseurs, artists, ethnologists, and students of comparative religion and folklore. There are sixty-eight plates, six of which are coloured, and 204 text figures, most of which are reproductions of Chinese drawings. The Field Museum of Natural History is to be congratulated on the publication of a monograph worthy of its most important and interesting collection of jade objects.

A. C. HADDON.

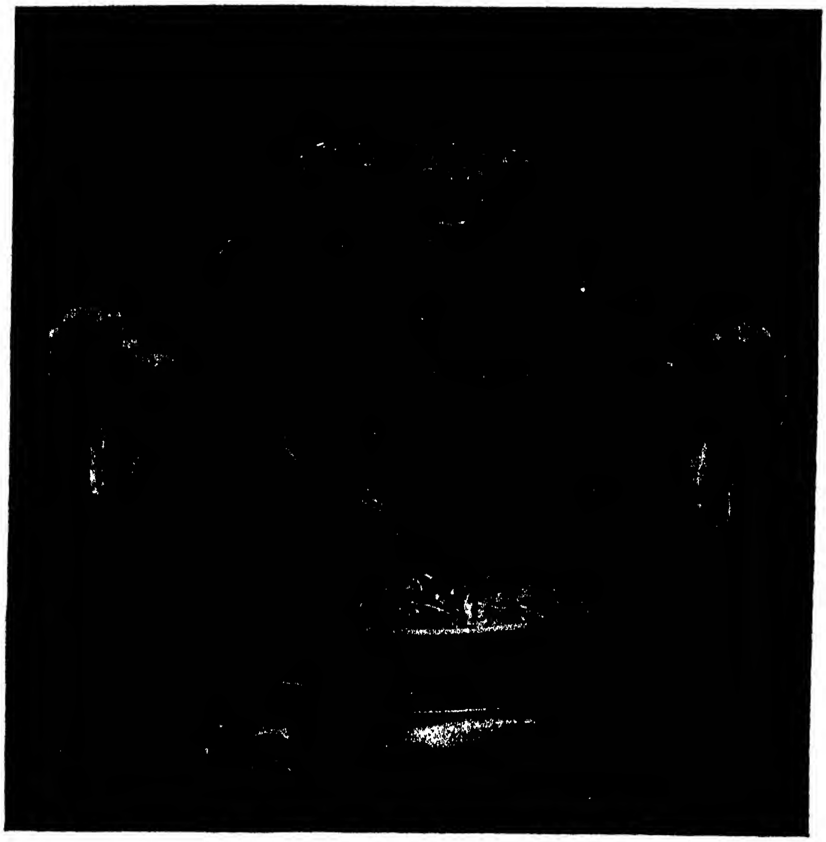


FIG. 2.—Incense-burner carved from white jade in open-work, Ming period. From "Jade: A Study in Chinese Archæology and Religion."

TECHNICAL EDUCATION IN INDIA.[1]

A REPORT on the results of an inquiry into the relation of technical instruction in India to the actual requirements of employers, which has recently been published, contains some valuable suggestions on the industrial outlook in that country. The inquiry is, however, strictly limited in scope. The report is not concerned with the general question of technical education, nor with the organisation or improvement of local industries; it deals with the more restricted and definite question of the value of the instruction now provided in Indian technical institutes in qualifying the students of those institutes to undertake positions as managers, heads of departments, foremen, and assistants in engineering, and in some few other industrial works.

Extensive inquiries have been made from the heads of engineering firms in different parts of India and also from the directors of instruction and the managers of some of the principal schools and technical institutions, and the results of these inquiries are embodied in certain definite recommendations, which have for their object the bringing into closer relation of the teaching of the schools with the actual needs of employers. The writers of the report, whilst giving due weight to the views of British engineers and educational authorities, have wisely recognised the fact—too often overlooked—that the conditions of industry differ very widely in India and in Western countries, and that the character, disposition, and aptitudes of native students must be considered in any proposals as to their education and training. The endeavour to impose upon institutions in India methods of instruction which may be well adapted to European students has produced results which are by no means satisfactory, and those who approach the problem of education from a scientific point of view realise that the character of the student, which is a product of his environment, must be considered in all educational schemes, and that the conditions of his training must be adapted to his habits and surroundings. This fact is recognised by the writers of the report when, at the outset of their inquiry, they state:—"It is useless training a man in mechanical engineering who will not take off his coat and work, whose physique will not stand the strain, or whose social customs make manual work repugnant."

The efforts already made to organise and develop education in India have clearly shown that the native student has a strong preference for studies dealing with the theories and principles of his subject over those demanding severe practical work or protracted scientific investigation. In many of the higher branches of handicraft the Indian is proficient, and it is a matter of some regret that greater efforts have not been made to develop technical instruction along lines which would have improved, and given greater artistic value to, many of the native industries. That suggestion, however, opens up a subject beyond the scope of the inquiry with which the report deals. The main object of the Commissioners was to ascertain what arrangements can be made for systematic co-

[1] Report on the Inquiry to Bring Technical Institutions into Closer Touch and More Practical Relations with the Employers of India. By Lieut.-Col. E. H. de V. Atkinson, R.E., and Tom S. Dawson. Pp. 100. (Calcutta, 1912.)

ordination between the work of technical institutes and the needs of employers with a view to active cooperation in the interests of the students and employers and for the general welfare of the country.

To effect this desirable end, great importance is wisely attached to affording to students ample facilities for practical work, not only in school laboratories and school shops, but under strictly commercial conditions in engineering and other industrial firms. Among the causes of the partial failure of Indian students to obtain suitable employment after leaving the technical institute some of the employers who were consulted state that "in most cases students from technical institutions will not work with their hands, will not observe factory hours, ask too high wages for learning their practical work, and generally think they know everything."

It is a fact that in their desire to obtain employment, whether as engineers or civil servants, Indian students undoubtedly attach too great a value to their school teaching, and the Commissioners recommend that school instructors and school managers should make it clear to their students that they are totally unfit for any position of authority immediately on leaving the institute, and must gain, under appropriate conditions of discipline, practical acquaintance with the details of the work in which they hope to be occupied. "Otherwise," they state, "there will always be a large number of men who fail to go further than the end of their college course." This is sound advice, which is not altogether inapplicable to British students. It is satisfactory to gather from the report that the writers are of opinion that Indians "if possessing the necessary character, theoretical knowledge, and practical experience, have more than equal chance of employment in India with Europeans." This statement will be read with equal gratification by those who are responsible in this country for the government of India as by the natives concerned.

Among the valuable recommendations set forth in the closing pages of this report, the importance of practical work is repeatedly emphasised. "The education given in the institute," we are told, "should be essentially practical, be capable of being applied commercially, and not of such high scientific character as is often considered necessary in the West." It is also pointed out that the "best method of training men in mechanical and electrical engineering to meet the existing demand is by a course at a well-equipped institute, followed by an apprenticeship in works."

India is waking up to the necessity of developing new and important industries. For the supply of the machinery needed to equip the increasing number of cotton mills now being erected in India, there will be a growing demand, and endeavours are being made to meet this demand by Indian enterprise and skill. The number of bleaching and dyeing works must be gradually increased with the development of the textile industries; and if only qualified students can be found who have received an adequate training in the technical institutes, new fields of employment will be opened up for native workers.

The report shows how the school may help the factory, and how the factory may offer a continually increasing number of remunerative posts to the trained students of the technical school. In addition to the general recommendations, the report contains useful suggestions for adjusting facilities for technical instruction to meet the demands of employers in the various provinces of India.

RESEARCHES IN RADIO-ACTIVITY.

SEVERAL communications from the Radium Institute at Vienna are before us, and a few of the most noteworthy are here mentioned.

In one of the recent communications from the institute Dr. O. Hönigsmid gives the result of a fresh atomic weight determination from the bromide, which confirms the value, 225·95, previously obtained from the chloride. Two determinations by conversion of the chloride into the bromide and *vice versâ*, the method adopted by Whytlaw-Gray and Sir W. Ramsay, also gave practically identical results. In conjunction with E. Haschek, a spectrographic examination of the preparations for barium was made. The barium line 4554·24 was not seen, and it was calculated from the effect of the addition of known small amounts of barium that the standard preparations could not have contained more than 0·004 per cent. of barium. This settles the question of the purity of the international radium standard, and of the true atomic weight of radium. It is characteristic of the time and of the accurate researches radio-activity has called forth, that the atomic weight of radium should now be one of the best-known constants, and far more certain than that of uranium and thorium.

In another communication, Dr. F. Paneth finds that polonium resembles a colloid in that it does not pass appreciably through animal membranes or parchment paper. Radio-lead may readily be separated from polonium by dialysis, the crystalloid salts of lead readily passing through the membrane and carrying the radio-lead with them in unaltered proportion.

Some further results of H. Molisch bring out the harmful effects of the radium emanation on growing plants when it is present above a certain degree of concentration. In lesser amounts a slightly favourable action on the growth is sometimes observed. The injury is a permanent one, the organs of the plant being affected and the leaves falling off. It appears to work like a poison chemically upon the cells, and considering the minute absolute amount of the emanation, there can be very few poisons which would produce in such small quantity so far-reaching destructive effects.

A. Brommer discusses the influence of the partial solar eclipse of April 17, 1912, on atmospheric electrification. During the first phase of the eclipse a well-marked diminution occurred in the number both of positive and negative ions in the atmosphere, the latter decreasing more rapidly than the former, so that an initial excess of positive ions was converted into a deficit. As the sun's disc again became uncovered, the number of ions increased and regained nearly their initial values, establishing a direct influence of sunlight on the ionisation of the atmosphere.

Exner and Haschek describe an unsuccessful attempt to find spectroscopic evidence of the existence of ionium in the thorium-ionium preparations separated from ten tons of Joachimsthal pitchblende by A. v. Welsbach. A similar attempt, with the same negative result, by A. S. Russell and R. Rossi, with the Royal Society's ionium preparation, is described in a recent number of the Proceedings of the Royal Society (p. 478). In view of the estimated period of ionium being from forty to one hundred times as long as that of radium, both these preparations should have contained a considerable proportion of ionium, and the failure to detect in their spectra a single line other than those due to known substances raises very important and fundamental questions.

A. Kailan, in three papers, deals with the influence

of ultra-violet light and of the penetrating rays of radium on various organic and inorganic compounds, and Meyer and Przibram discuss, among other phenomena, the effect of exposure to radium rays in increasing the "Hallwachs effect" in minerals.

Meyer and Paneth have undertaken a re-investigation of the proportion of α rays in a uranium mineral due to the uranium and radium respectively, which they find to be 100 : 57·3, instead of 100 : 45, as found initially by Boltwood. The new ratio agrees perfectly with the present view that uranium consists of two elements, uranium I. and II., each emitting one α ray per atom disintegrating, of ranges respectively 2·5 and 2·9 cm. of air at 15°, with which the older ratio was seriously in disagreement.

Lastly, Hess deals with the heat generated by a pure radium salt at the moment of its preparation, when it is free from the products of disintegration, and finds it to be 25·2 calories per hour per gram of radium (element). In the course of a month, in which the first four products accumulate to the equilibrium quantity, the heat generated increases by 107·1 cal. per hour, the total (for α and β rays, and 18 per cent. of the γ rays) agreeing perfectly with his previous measurements in collaboration with Prof. Meyer on a different preparation. As an example of the perfection to which our knowledge of the processes of atomic disintegration has been brought, and to which it would perhaps be difficult to find a parallel elsewhere in the molecular sciences, it may be mentioned that the figure 25·2 calories per hour per gram of radium agrees, within 1 per cent., with the value deduced from Rutherford's direct measurements of the number, mass, and velocity of the α particles expelled by radium, taking into account the kinetic energy of recoil. An analogy to this would be a determination of the "heat-drop" of steam by counting the number, measuring the individual mass, and determining directly the velocity of the molecules leaving a turbine-jet. F. S.

SCIENTIFIC WORK OF THE CENTRAL CHEMICAL LABORATORY OF THE ITALIAN CUSTOMS.

THE report of the year's work of the Central Chemical Laboratory of the Italian Customs at Rome (*Annali del Laboratorio Chimico Centrale delle Gabelle*, vol. vi., 1912, pp. xxxvii+707), under the direction of Prof. V. Villavecchia, which has recently been issued, contains an introductory article by the director on the history of its twenty-five years' activity since its inauguration in 1885. In this period 225,679 analyses have been made, and 1524 special reports prepared for various Government departments, whilst 127 original papers have been published in the *Annali* issued from the laboratory. Recently a museum of commercial products and raw materials has been established in connection with the Central Laboratory, care being taken to ensure the genuine character of all the specimens, so that they can be used as standards of reference by the Government chemists; an account is given in the report of the 32,382 samples collected for this museum, and a description of the building.

In the present report some of the most important original contributions are as follows. I. Barboni has investigated comparatively the different methods which have been used for the analysis of commercial calcium citrate, and reports on their suitability. A. Capelli, in examining the alkaloids contained in maté, has been able to separate only caffeine, although the statement has been recently made that caffeine is present only in traces, the principal alkaloid being matteine. There is a series of papers by R. Belasio on the electrolytic estimation of zinc, the separation by electrolysis of iron and manganese, the analysis of white metals and tinfoil, the detection of antimony and of tin in metallic alloys, and a description of the electrolytic methods of analysis in use in the laboratory of the *Gabelle*. Among papers dealing with organic analysis the following may be cited:—G. Testoni, the estimation of sucrose in the presence of other sugars; E. Castaldi, the Halphen test for cotton-seed oil; L. Settimj, a characteristic colour reaction for soja-bean oil; S. Camilla and C. Pertusi, the detection and estimation of the xanthine bases in cocoa, tea, and coffee; V. Villavecchia and A. Capelli, the quantitative estimation of cotton, wool, and silk in mixed fabrics.

Independently of its work of routine analyses for the control of commercial and dutiable articles, the laboratory is carrying out valuable work in investigating the many different and often conflicting methods of analysis in current use, and, when necessary, devising new processes to meet freshly arising needs.

THE HYDROMETER AS AN INSTRUMENT OF PRECISION.[1]

MR. J. Y. BUCHANAN publishes in the Transactions of the Royal Society of Edinburgh (vol. xlix., part i., 1912) the results of extended researches on the specific gravity and the displacement of some saline solutions. The memoir, which occupies 225 quarto pages, deals with the densities and variations in densities of certain groups of saline solutions; but although the results obtained are themselves of interest and value, the importance of the work centres rather in the detailed study of the use of the hydrometer as an instrument for work requiring a high degree of accuracy. This importance, of course, arises mainly from the fact that ever since the days of the *Challenger* expedition, Mr. Buchanan has been the principal champion of the hydrometer method for determining the specific gravities of samples of sea-water for purposes of oceanography, and that the method has now for many years been practically disused by most oceanographers.

Two forms of hydrometer are described. In the "closed" type—that ordinarily used for, *e.g.*, sea-waters—the weight of the instrument is varied by adding to or subtracting from a number of weights placed on the top of the glass stem of the hydrometer. The additional weights are obviously limited by questions of stability, for if too much weight is accumulated at the top of the stem the whole instrument will tend to capsize. Solutions of high density are therefore treated with an instrument of the "open" type, in which the stem is left open at the top instead of being hermetically sealed, and the paper scale is replaced by one etched on the stem itself. The internal ballast can then be altered by varying the amount of mercury or the number of lead pellets, as the case may be, and the final adjustment by weights at the top of the stem made without risk of the instrument swinging out of the vertical.

Every worker with the closed type of instrument (that used on board the *Challenger*) knows that the real difficulty is not to get consistent results, but to get accurate results, or results which will either agree with those obtained by other methods or differ from them in some way which can be accounted for. Much labour has been expended by many investigators in efforts

[1] "Experimental Researches on the Specific Gravity and the Displacement of Some Saline Solutions." By J. Y. Buchanan, F.R.S. (Trans. R.S.E., vol. xlix., part i., 1912.) Pp. 227. (Edinburgh: Neill and Co., Ltd., 1912.) Price 7*s.* 6*d.* net.

to reconcile the differences observed. Mr. Buchanan, however, does not enter into the question, but restates the position he took up in a paper read at the International Geographical Congress in 1895, to the effect that this type of hydrometer gives not comparative but absolute results, and is "a pyknometer where the volume of liquid *excluded* up to a certain mark is weighed instead of that *included* up to a similar mark."

GERMAN METEOROLOGICAL REPORTS.

THE organisation reports of (1) the Royal Prussian Meteorological Institute (Berlin) and (2) the Deutsche Seewarte (Hamburg) for the year 1912 have been recently published. The operations of these establishments are quite distinct; the institute dates from 1847, as a department of the Statistical Bureau, under Dr. W. Mahlmann, to whose life and work a special article is devoted in the report for this year. The work of the institute (which became an independent meteorological organisation in 1886) consists to a considerable extent of special scientific researches which appear in the *Abhandlungen* and elsewhere, and in the preparation and publication of the observations made at a large number of stations, separate departments dealing specially with meteorology, rainfall, and thunderstorms. It also controls the work of Potsdam Observatory, which undertakes various branches of geophysical investigation. Among the various discussions in this year's report we may mention an interesting inquiry into the Thuringian deluge of May, 1613, by Dr. Hellmann (director).

The Deutsche Seewarte (Hamburg) may be said to date from 1867, under Dr. W. v. Freeden, and was established as a Government institution in 1875; its great work, which is well known to our readers, will always be associated with the name of Dr. v. Neumayer. It deals with all branches of maritime meteorology and weather telegraphy, and controls a limited number of meteorological and storm signal stations. Among its many useful publications may be mentioned (1) monthly meteorological charts of the North Atlantic, observations at many oversea stations and colonies, a laborious and useful atlas of daily synchronous weather charts for the North Atlantic (in conjunction with the Danish Meteorological Institute), also scientific discussions in the *Archiv der Deutschen Seewarte* and elsewhere. During the year 1912 it received 4391 months' observations taken on board ship, and made 351 ascents by kites, captive and pilot balloons, in connection with the exploration of the upper air.

ORNITHOLOGICAL NOTES.

ACCORDING to the Journal of the South African Ornithologists' Union for December, 1912, a special effort is being made to arouse interest in the dates of arrival and departure of the local migratory species, such as the bee-eater, red-legged kestrel, swallow, and golden oriole. With this object in view, school teachers willing to assist are to be admitted to associate membership at a greatly reduced subscription.

Mr. Gregory Mathews is to be congratulated on the completion, with No. 8, of the first volume of *The Austral Avian Record*, this part including a notice of birds described by Gould from Norfolk, Lord Howe, and Philip Islands.

It has long been known that certain kinds of birds—especially hornbills—are in the habit of periodically shedding and casting the lining membrane of their gizzards. According to a letter from Mr. D. Macintyre published in *The Field* of March 31, and an article by Mr. H. H. Smith in the April number of *British Birds*, the curlew must be added to the small list of species in which this strange act occurs.

In the January issue of *The Ibis* Dr. Sclater contrasts the new "Hand-List of British Birds," by Dr. Hartert and others, with the list issued by the British Ornithologists' Union in 1883, and points out that out of the 376 species included in the latter the names of no fewer than 200 would have to be changed if the nomenclature of the "Hand-List" were accepted. Dr. Sclater considers it undesirable to take the tenth, in place of the twelfth, edition of the "Systema Naturæ" as the basis of our zoological nomenclature, and points out that according to the Stricklandian code "tautonyms" are prohibited, while liberty to correct mistakes and bad grammar is permitted. "If," he adds, "we take Latin for the language of science, we are surely bound to follow its grammatical rules."

PROMOTION OF RESEARCH BY THE CARNEGIE INSTITUTION OF WASHINGTON.

THE Year Book for 1912 of the Carnegie Institution of Washington has now been issued. The record of work accomplished contained in its pages shows there has been no diminution in the efforts of the trustees to secure a wise expenditure of the funds placed at their disposal for the advancement of research in science.

The following list shows the departments of investigation to which the larger grants were made by the trustees and the amounts allotted from these grants by the executive committee during the year:—

	£
Department of Botanical Research	7,600
Department of Economics and Sociology ...	2,500
Department of Experimental Evolution ...	7,500
Geophysical Laboratory	15,000
Department of Historical Research	5,300
Department of Marine Biology	3,600
Department of Meridian Astrometry	5,200
Nutrition Laboratory	9,700
Division of Publication	2,000
Solar Observatory	51,000
Department of Terrestrial Magnetism ...	19,600
	129,000
Transferred from Nutrition Laboratory to unappropriated fund	1,000
	130,000

Numerous minor grants were made, amounting to very nearly 40,000*l*., and grants for publication authorised during the year reached a total of about 8600*l*. During the year 1912 the income of the institution was almost 250,000*l*., and the total expenditure some 229,600*l*.

The following extracts from the *résumé* of the investigations of the year included in the report of the president of the institution, Dr. Robert S. Woodward, will give some indication of the work which has been inaugurated and encouraged:—

Although the departments of investigation, like the institution as a whole, have fallen short of popular expectations in the rapidity of their growth, it now appears plain, in the light of their actual experience, that this growth has been somewhat too rapid for safety. Along with this rapid growth and with the signal success of the departments in their several fields of research, there are now coming also numerous requests for cooperation with other organisations and

with individuals. But while these requests are in general gratifying and often praiseworthy, they present some obvious hazards. There is need, therefore, of constant caution against the dangers of undue expansion and affiliation which lead to dissipation of effort and resources. It should be kept in mind that concentration on definitely limited programmes, continuity of effort, and energetic assiduity are the factors most essential to progress in the domain of research.

The geographical range of the work of the department of botanical research, which centres in the Desert Laboratory at Tucson, Arizona, has been extended during the past year to include certain portions of the deserts of northern Africa. Studies have been continued at the Desert Laboratory, at the Carmel Laboratory on the California coast, at Salton Sea, and at various substations where observations are made on the phenomena presented by plants under strikingly varying conditions. One of the most important investigations undertaken during the past year is that of a comprehensive study of the large and highly diversified family of cactus plants.

The advances made by the department of experimental evolution during the past year have been chiefly along the lines of studies in cytology, in the chemistry of pigmentation, in the factors of mutation, and in the problems of human heredity. These studies have been carried on by aid of experiments with plants and animals and by aid of rapidly accumulating statistical data concerning human traits and their transmission through successive generations. The director has been able to give much of his time to studies in human heredity by reason of his connection with the Eugenics Record Office. Very interesting chemical studies have been carried on by Dr. Gortner, a member of the staff, in respect to the chemical nature of pigments which determine colour characteristics, especially of the plumage in birds, of the wool in sheep, and of the skin in men. Dr. Shull has continued his fertile studies into the heredity of plants, including further investigations into the connection between heredity and environment in the case of corn. These further studies confirm his earlier conclusions and show also that the hereditary traits of different strains are maintained irrespective of environmental influences.

Two specially noteworthy publications of the geophysical laboratory have been issued during the year by the institution, namely No. 157, "High Temperature Gas Thermometry," and No. 158, "The Methods of Petrographic-Microscopic Research." The purpose of the first of these was to give an account of the apparatus and methods for accurate measurement of the critical temperatures incident to mineral combinations; and the object of the second is to place, so far as practicable, microscopic study of minerals upon a quantitative basis.

Special attention is directed in the director's report to extended studies on quartz and other forms of silica, which is the most widely diffused ingredient in rock masses; to further experiments on the conditions of association of the three oxides, lime, alumina, and silica, which in addition to being the commonest components of igneous rocks, are also incidentally the three principal ingredients of the so-called Portland cement; to mineral sulphides, which are often of great economic importance; and to mineral and rock densities.

Perhaps the most interesting of the more recent investigations of the laboratory are those of the physics and chemistry of active volcanoes undertaken tentatively a year ago and pursued with very gratifying success during the past summer. It has proved practicable for members of the staff to descend into the crater of Kilauea and to collect considerable quantities of gas as it emerged from the liquid lavas of the crater. Specimens of gases were collected in glass tubes without contamination from the air, and these have been brought to the laboratory at Washington for detailed study. There seems little reason to doubt that the phenomena of vulcanism will be ultimately revealed by the methods, apparatus, and technique developed by the staff of the laboratory.

The independent transportation facilities furnished by the new vessel, *Anton Dohrn*, and the repairs and improvements to the laboratory completed a year ago, have proved highly advantageous to the department of marine biology. By means of the *Anton Dohrn* the entire Gulf and West Indian region becomes open to investigation by the department. The director records with appreciation a gift to his fleet by Hon. John B. Henderson, of Washington, D.C., of a 23-ft. 6-h.p. launch, which has already proved a very useful adjunct in the diversified work of the department, since many different investigations are carried on simultaneously by different individuals at the laboratory headquarters. During February and March of the current year the director established a temporary laboratory at Montego Bay, Jamaica, a region which sustains important biological relations to the vicinity of the Tortugas group of islands. The director of the department has issued, as No. 162 of the publications of the institution, an additional volume of his series on the jelly-fishes of the world, the title of this volume being "Ctenophores of the Atlantic Coast of North America."

Special attention has been given in the department of meridian astrometry to the reduction of the meridian observations made at San Luis, Argentina. The determination of the two coordinates of stars from this work, namely right ascension and declination, have proceeded simultaneously. The assignment of stellar magnitudes, however, must await the photometric determinations which have been made at San Luis since the meridian measurements were completed. Late advices announce that it will be completed by the end of the present calendar year. The great quantity of priceless observational and derived data accumulated by the department rendered it imperative that special provision should be made for their safe storage. Accordingly the executive committee authorised the construction of a fireproof vault within the walls of the Dudley Observatory. This vault is now ready for occupation and the records will be placed therein as soon as practicable.

One of the most interesting of the many investigations under way in the nutrition laboratory during the year is that of the metabolism of a subject who underwent a prolonged fast, extending to thirty-one days without food, and drank only distilled water during this time. This investigation required the cooperation of a number of chemical, pathological, and psychological experts. A detailed report on this elaborately observed experiment is at present in preparation. Another noteworthy investigation of the year is that on metabolism during severe muscular work, undertaken by Dr. E. P. Cathcart, of the University of Glasgow, who was a research associate of the institution during the winter of 1911–12. Amongst other important results of the latter research is the measure it affords of the mechanical efficiency of man. An account of this investigation is likewise in preparation for publication.

Highly effective progress has been made by the department of terrestrial magnetism during the past year in its magnetic survey of the globe. By means of the non-magnetic ship *Carnegie* it is now easier to make a magnetic survey of the ocean areas than of

the land areas, for the former are now more readily accessible than the latter. At the end of the preceding fiscal year the *Carnegie* was at Batavia, Java. On November 21, 1911, she set sail for an additional circuit of the Indian Ocean, when she proceeded to Manila, Philippine Islands, where she arrived February 3, 1912. From Manila she proceeded to Suva, thence to Tahiti, and afterwards to Coronel, Chile. During the fiscal year she traversed about 28,000 miles. Her courses are arranged to intersect as frequently as possible her own previous tracks, those of the *Galilee*, and those of previous expeditions on which magnetic elements were observed. Valuable checks on the determinations of these elements are thus secured, and in case of considerable intervals between the dates of different determinations, data for secular variation of the magnetic elements are also obtained. As related in the report of a year ago, unexpectedly large errors were found in the best magnetic charts of the Indian Ocean and for some parts of the Pacific Ocean.

Observations have been continued simultaneously on land areas, embracing portions of five continents and about twenty different countries. Many noteworthy series of transcontinental stations have now been completed. Of these, one extending across the entire continent of South America, beginning at Para, at the mouth of the Amazon, and extending to Callao on the Pacific coast, by way of the Amazon and Ucayali rivers and Lima, has been finished during the past year.

The past year has been one of minimum sun-spot activity; but effective progress has been made in many other branches of solar and stellar research undertaken by the solar observatory. The wide range of this work may be indicated by the fact that the results of the investigations of the year are summarised by the director under thirty-five different heads. The new tower telescope has been completed, and important auxiliary apparatus has been added to the equipment of the 60-in. reflector. A fireproof office building, which will afford adequate quarters for the staff and safety for the original records and photographic plates of the observatory, has been constructed and made ready for occupancy during the year.

The 150-ft. tower telescope with its spectrograph and spectroheliograph has been tested and found to be quite up to expectations. The 60-in. reflector has proved increasingly effective in the wide variety of work undertaken with it. Between forty and fifty new spectroscopic double stars have been found; and amongst the many stars the radial velocities of which have been measured is one which surpasses all others hitherto observed, its velocity being about 150 miles per second.

Two eminent research associates, namely Prof. Kapteyn, of Groningen, and Prof. Störmer, of Christiania, have taken part in the work of the observatory during the year.

The laborious task of shaping and testing the glass disc for the proposed 100-in. telescope has proved a disappointment in showing that this disc, which was accepted provisionally from the makers several years ago, will not answer the requirements. It appears possible that some expedients may be adopted to overcome the instability of this disc; but the probability that it may be made to work satisfactorily is small. In the meantime the makers of such large discs have not succeeded in making one of sufficient uniformity in density. In view of these difficulties the director is disposed to try a thinner disc if one can be found possessing the requisite degree of homogeneity. Thus this project must suffer further delay, although it is practically certain that the difficulties presented may be ultimately overcome.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The subject selected for the Adams prize in 1914 is "The Phenomena of the Disturbed Motion of Fluids, including the Resistances encountered by Bodies moving through them." A theoretical re-discussion of the problem of fluid resistance may be undertaken, either in general or in simple cases, in the light of the experimental knowledge regarding the resistances and the nature of the broken motion of the fluid which is becoming available in the publications of the aëronautical laboratories of various countries. Information has been accumulating regarding the nature and mode of travel of meteorological atmospheric disturbances, such as cyclonic movements and line squalls, the propagation of minute waves of barometric pressure, and the nature of the lower boundary of the upper calm region of the air. A dynamical discussion of these topics, or of simpler problems in illustration of them, might be undertaken. The prize is open to the competition of all persons who have at any time been admitted to a degree in the University of Cambridge. The value of the prize is about 220*l*. The essays must be sent to the Vice-Chancellor on or before the last day of December, 1914.

The Linacre lecture at St. John's College will be delivered by Dr. Norman Moore, on Tuesday next, May 6, on the physician in English history.

The professor of botany has recently received for the botanical museum a collection of 100 water-colour studies of Italian and other South European flowering plants from Mrs. Latimer-Jackson. The sketches, which were made by Mrs. Latimer-Jackson in the course of several visits to Sicily and different parts of the mainland, have not only great artistic merit, but will be useful to students and of considerable interest to many members of the Senate other than professional botanists.

A syndicate has been nominated to consider what changes, if any, are desirable in the regulations relating to the Previous Examination, in the mutual relations of the Previous Examination and the examinations held by the Highest Grade Schools Examination Syndicate and the Local Examinations and Lectures Syndicate, and in the relations of the Previous Examination to examinations held by other bodies. The syndicate has power to confer with the Highest Grade Schools Examination Syndicate, the Local Examinations and Lectures Syndicate, and such other bodies and persons as it may think fit. This is another attempt to bring what is practically the entrance examination of the University into line with modern thought.

OXFORD.—On April 29 Congregation approved a decree authorising the expenditure of 600*l*. in adapting the chemical laboratory at the museum to the immediate needs of the Waynflete professor of chemistry (Prof. W. H. Perkin).

WE learn from *Science* that Princeton University has received three gifts: 20,000*l*. from Mr. and Mrs. Russell W. Moore, of New York City, to endow a professorship of chemistry; 25,000*l*. given anonymously for a professorship not named; and 6000*l*. from Mr. J. D. Cadawallader, of New York City.

THE London County Council will be prepared to award for the session 1913–14 a limited number of free places at the Imperial College of Science and Technology, South Kensington, S.W. The instruction will be of an advanced nature, and therefore only

advanced students who are qualified to enter on the fourth year of the course should apply. There is no restriction as to income, but intending candidates must be ordinarily resident within the area of the administrative County of London, and must be students who have been in regular attendance at appropriate courses of instruction for at least two sessions. The free studentships do not entitled the holders to any maintenance grants, but cover all ordinary tuition fees. The free places will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study which they intend to follow, and generally upon their fitness for advanced study in science as applied to industry. Candidates will not be required to undergo a written examination. Application forms (T. 2/268) may be obtained from the Education Officer, L.C.C. Education Offices, Victoria Embankment, W.C., and must be returned not later than Saturday, May 24.

VACATION courses for foreigners are to be held in Hamburg from July 24 until August 6 next. In all seventy-five lectures and courses have been arranged in connection with the scientific institutions of the State of Hamburg, with the hospitals and the Colonial Institute. The courses will aim at acquainting foreigners with the position of scientific studies in Germany. Scientific problems of the day will be treated by competent specialists in a manner intelligible to educated persons. Some sixty-five professors from German universities and institutes will assist at the courses. For the convenience of foreigners, special practical courses in German have been arranged daily between June 16 and July 26. These courses offer an opportunity of acquiring a practical knowledge of the language. Courses have been arranged also for medical students, including practical work at the Eppendorf Hospital, and a series of lectures on diseases of the heart and lungs. Students will be given opportunities of sight-seeing in Hamburg and its environs. Prospectuses and all information may be obtained gratis on application to "Geschäftsstelle der Akademischen Ferienkurse," Hamburg 20, Martinistrasse 52.

THE organiser for technical education in the Transvaal, Mr. W. J. Horne, has amplified a paper he read before the South African Institution of Engineers at Johannesburg shortly after the establishment of the Johannesburg Trades School, and the result is a volume on the Trades School in the Transvaal, a copy of which has been received. After explaining the need for vocational instruction, he gives a description of the character and scope of the work done in the urban trades schools of the Transvaal, explains the nature and cost of the buildings and equipment in different centres, and reviews what is being done to meet the special needs of rural areas on one hand, and of girls on the other. The volume shows that considerable progress has been made already in the provision of technical education in the Transvaal. The Pretoria Trades Schools and Polytechnic, for example, has accommodation for 200 pupils, and is provided with shops for blacksmiths and farriers, workers in wood, electricians, mechanical engineers, plumbers, wagon-builders, and printers. As Mr. J. Percy FitzPatrick, the chairman of the Witwatersrand Council of Education, says, in the introduction he contributes to the volume, "the motto of the Transvaal Trades Schools is 'theory and practice.'" and Mr. Horne insists that the mission of the trades schools must be to unite and harmonise these two essential things. The volume is full of practical suggestions for ensuring this end and of providing means for boys and girls to proceed as far in their study of technology as their capabilities permit.

THE Indian newspapers recently received in this country contain fuller particulars of what is in future to be the Government policy with regard to education in India. The statement circulated in India in February last, we learn from *The Times*, after a recognition of the beneficial effects of the Universities Act of 1904, refers to the new decentralising policy. It is pointed out that there are only five Indian universities for 185 art and professional colleges in British India, besides several affiliated institutions in native states. The day is probably far distant, it is remarked, when India will be able to dispense altogether with the affiliating university. But it is necessary to restrict the area over which the universities have control, securing in the first instance a separate university for each of the leading provinces, so far as possible on a teaching and residential basis. A university of this new type is being founded at Dacca, and the establishment of universities at the provincial capitals of Rangoon, Patna, and Nagpur is contemplated. The Government is also prepared to sanction, under certain conditions, teaching and residential universities at Aligarh and Benares, and elsewhere as occasion may demand. The importance of secondary- and high-school education as the basis of all professional or industrial training in India is emphasised. Private enterprise in this field is so extensive that of 3,852 high and middle English schools only 286 are Government institutions. Unsatisfactory schools have in certain cases gained recognition and eluded the control of inspection. The Government intends to increase largely the grants-in-aid in order that non-State institutions may keep pace with improvements in Government schools; to multiply and improve training colleges; and to found Government schools where a survey of local conditions leads to the conclusion that they are needed. The provision for technical, industrial, and scientific studies is surveyed, and incidentally the statement is made that "the grave disadvantages of sending their children to England to be educated away from home influence at the most impressionable time of life are being realised by Indian parents."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 24.—Sir Archibald Geikie, K.C.B., president, in the chair.—A. G. **Huntsman**: (1) Protostigmata in Ascidians. (2) The origin of the Ascidian mouth.—F. A. **Bainbridge**, S. H. **Collins**, and J. A. **Menzies**: Experiments on the kidneys of the frog. When the frog's kidneys are perfused through the aorta and the renal portal veins with oxygenated normal or hypotonic Ringer's solution the urine formed is hypotonic to the perfusing fluid and is derived entirely from the glomeruli, since the tubules secrete no urine under these conditions. When the tubules are poisoned with corrosive sublimate or (temporarily) with caffein the urine becomes isotonic with the perfusing fluid. On the contrary, if the glomeruli are killed by the arterial perfusion of boiled Ringer's solution, while the tubules still receive an adequate supply of oxygen through the renal portal veins, the urine formed continues to be more dilute than the perfusing fluid.—Cecil **Revis**: (1) The probable value to *Bacillus coli* of "slime" formation in soils. When kept in sterilised soils, particularly if these contain excreta, *B. coli* shows a great tendency to the formation of "slime," a property which is retained for some time when the organism is plated out on ordinary

nutrient media. It has been found that soils so inoculated with *B. coli,* together with other soil organisms of a sporogenous type, are able to retain and absorb moisture from the air in a remarkable manner, so that during a period of three years flasks containing these soils and only closed with cotton-wool plugs retained and even increased the original water added to them, whilst controls which did not contain the colon organism rapidly dried up.—C. **Revis**: Variation in *B. coli.* The production of two permanent varieties from one original strain by means of brilliant green. From the experiments it appears (1) that from one single cell there may arise new cells differing in the power of resistance to the same environment and consequently modified by it in a different manner; (2) that the exhibition of physiological activity is not an intrinsic and integral part of the protoplasm, but that such powers may be entirely lost without loss of vitality in the organism itself.

Zoological Society, April 15.—Sir J. R. Bradford, K.C.M.G., F.R.S., vice-president, in the chair.—C. Tate **Regan**: (1) Fishes from Easter Island collected by Prof. F. Fuentes. The collection included examples of ten littoral species, four widely distributed in the tropical Indo-Pacific and six new to science; of the latter two were related to tropical forms and the rest to species described from New South Wales or from Norfolk Island. (2) A revision of the fishes of the genus Kuhlia; twelve species were recognised, including three described as new to science.—R. I. **Pocock**: The affinities of *Canis antarcticus.* It was shown that (1) *C. antarcticus* and *C. latrans* are not closely related, as has been claimed; (2) the affinities of *C. antarcticus* lie with certain South American species of Canidæ; and (3) *C. latrans* must be affiliated with the wolves and large jackals of the northern hemisphere. These conclusions were based mainly upon cranial and dental characters, and the points were illustrated by a series of lantern-slides of the skulls of several species of Canidæ.—Major G. E. H. **Barrett-Hamilton** and M. A. C. **Hinton**: A collection of mammals from the Inner Hebrides. This collection was made during an expedition organised and managed by Mr. W. R. Ogilvie-Grant. Three new forms were discovered: of these one (*Sorex grantii*) is regarded by the authors as an insular development of *S. araneus,* whilst they are inclined to think that the other two (*Evotomys alstoni* and *Microtus agrestis macgillivrai*) are slightly modified survivals from the Pleistocene period. The authors argue that the evidence shows that Islay, and perhaps Jura, were separated from the old Hebridean land-area as well as from the mainland of Scotland earlier than were the other islands. Secondly, they think it likely that the severance of the Hebridean district transpired before that of the Orkneys. Lastly, they consider that the evidence of the mammals supports the suggestion of a former direct land-connection between western Norway and the Hebrides, put forward by Stejneger.—R. **Lydekker**: *Bubalis caama selbornei,* subsp. n., a male hartebeest from the Transvaal.

Royal Meteorological Society, April 16.—Mr. C. J. P. Cave, president, in the chair.—W. H. **Dines**: The vertical distribution of temperature in the atmosphere and the work required to alter it. It seems likely that the vertical distribution of temperature is the result of two opposing tendencies, one the effect of radiation, and the other the forced mixing produced by the general circulation, aided perhaps by the convection caused by the heating of the earth by solar radiation and by the latent heat set free by condensation.—J. E. **Clark** and R. H. **Hooker**: Report on the phenological observations for the year ending November, 1912. The chief factors affecting the field crops were probably the dry warm April and May, followed by the cold wet sunless summer. The spring was perhaps the more important of the two; it affected the corn crops and the hay. All the crops in the United Kingdom were below the average of the preceding ten years, although in Great Britain alone meadow hay was a little better than usual, and hops were also above the mean by fully 23 per cent. The harvest of 1912 must thus be classed as very deficient, and one of the worst experienced for many years.—R. **Corless**, G. **Dobson**, and Dr. C. **Chree**: Meteorological, electrical, and magnetic observations during the solar eclipse of April 17, 1912. The observations discussed were mostly made at the Meteorological Office, South Kensington, and Kew Observatory. The temperature fell nearly 3° during the eclipse, the minimum occurring ten minutes after the maximum phase. At stations in the south of England the loss of recorded sunshine due to the eclipse varied from about twenty to twenty-five minutes.

DUBLIN.

Royal Irish Academy, April 14.—Rev. Dr. Mahaffy, president, in the chair.—H. **Kennedy**: The large ions in the atmosphere. This paper is a continuation of work by Prof. McClelland and the author. The previous work had reference to the air of the city, and it was suspected that flames of various sorts were chiefly responsible for the large ions observed. This view was supported by laboratory experiments showing that ions of the same mobility (1/2000 cm. per sec.) were present in flame gas when allowed to cool. Observations were therefore made at Dalkey, about eight miles from Dublin, at a point on the coast, so that tests could be made of air from over the sea, from country districts, or coming from the city. The average number of large ions per c.c. previously observed in Dublin was 16,000, with a maximum of 54,000. At Dalkey the average was about 1000, and numbers as low as 200 were observed. Only when the air was coming from the city to the place of observation or during fogs were large numbers observed. The paper also contains further data on the relation between the numbers of small and large ions present. The small ions increase in number with the decrease of large ions present.—R. **Southern**: (1) Oligochæta (Clare Island Survey); (2) Gephyrea (Clare Island Survey). (1) Oligochæta. Thirty-four species were recorded. The earthworm fauna of Clare Island was poor, only fourteen species being found. Two new species of the family Enchytræidæ were described, the first, *Enchytraeus cliarensis,* living in weeds on the shore. The second species was of considerable interest, being the first undoubted Oligochæte found below low-water mark. Its remarkable characteristics necessitated the creation of a new genus, and the species was named *Grania maricola.* It was dredged in twenty-four fathoms in Clew Bay. It is closely related to *Enchytraeus monochaetus,* described by Michaelsen from South Georgia, an island in the South Pacific, a species which evidently belongs to the genus Grania. The chief character of the genus is the great reduction in the number of setæ, which are quite absent from the anterior end of the body. (2) Gephyrea. Ten species were recorded from the district. The most interesting were *Aspidosiphon mülleri,* Diesing, and *Phascolosoma intermedium,* a new species dredged in twenty-four fathoms, showing characters intermediate between the genera Phascolosoma and Phascolion.

PARIS.

Academy of Sciences, April 21.—M. F. Guyon in the chair.—A. **Haller**: The formation of tetra-alkyl derivatives of *cyclo*hexanone and β-methyl*cyclo*hexanone and of trialkyl derivatives of menthone.

Using the method with sodium amide, previously described by the author, all of the four hydrogen atoms of the two carbon atoms adjacent to the ketone group can be replaced by methyl or allyl; the introduction of the ethyl group offers difficulties. Full details of the preparation and properties of the compounds obtained by the application of the reaction are given in the paper.—M. de **Forcrand**: Thermochemical study of uranyl nitrate and its hydrates.—M. **Sabatier** was elected a member of the section of non-resident academicians, and M. Jules Boulvin a correspondant for the section of mechanics.—H. **Burkhardt**: A theorem on the gamma function.—Michel **Petrovitch**: The entire transcendentals generalising exponential and trigonometric functions.—A. **Billmovitch**: Conservative non-holonomial systems with linkages dependent on the time.—Jules **Andrade**: Friction and isochromism of the double spiral. A remarkable property of a group of double spirals suitably chosen A solution of a problem in chronometry.—Louis **Roy** The motion of indefinite viscous media.—L. **Décombe** The electronic theory of gravitation.—Henri **Bénard** The structure of vortices behind an obstacle. The motion has been studied with the aid of the kinematograph, and a reproduction of a film is given.—C. **Dauzère**: A new species of cellular vortices. A study of the eddies produced in the surface of molten stearic acid.—M. **Deslandres**: Remarks on the preceding communication of M. Dauzère, pointing out the analogy between the phenomena observed by M. Dauzère and those occurring in the atmosphere.—A. **Blondel**: The nitometer, an apparatus for rapidly measuring the brilliance of a luminous surface.—G. **Sizes**: The transversal vibrations of strings.—A. **Portevin**: The elastic limit of alloys. The method used was based on the appearance of the slip bands on the polished surface of the specimen. Six reproductions of microphotographs illustrating the results obtained with different alloys are given.—Georges **Charpy** and André **Cornu**: The transformations of the alloys of iron and silicon. The measurement of the coefficient of expansion of the alloy was utilised as a means of following the transformations instead of the more usual cooling velocity. The critical points obtained by the two methods do not agree.—Daniel **Berthelot** and Henry **Gaudechon**: The dissociation of gaseous compounds by light. The gases ammonia, phosphoretted hydrogen, arseniuretted hydrogen methane, silicon hydride, zinc ethyl, phosgene, sulphur hexafluoride, were submitted to the light from a mercury-vapour lamp. Of these sulphur hexafluoride and methane were the only gases unaffected. —Ch. **Maguin**: The orientation of liquid crystals by sheets of mica.—G. **Lafon**: The use of fat in the animal organism. Fats can be utilised directly, similarly to glucose, particularly in muscular work.—E. **Wertheimer** and G. **Battez**: The mechanism of the salivary secretion produced by the injection of saline water into the vessels. It is shown that the action is almost entirely due to the effects on the nerve system.—André **Mayer** and Georges **Schaeffer**: Lipocytic coefficients and the imbibition of living cells by water. It is proved that there is a numerical relation between the lipocytic coefficient of tissues and their maximum imbibition by water.—Maurice **Arthus**: Experimental researches on the poison of *Buthus quinquestriatus*.—L. C. **Soula**: The relations between anaphylaxy, immunity, and autoproteolysis of the nervous centres. The state of anaphylaxy is accompanied by a marked increase of autoproteolysis of the nerve centres.—Marcel **Belin**: The relations existing between anaphylaxy and immunity. A study of the effect of the injection of oxidising agents on the toxines of tetanus, colibacillus, and vaccine.—Albert **Robin**: The metabolism of the urinary chlorides in cancerous subjects.—Em. **Bourquelot** and Em. **Verdon**: Researches on the biochemical synthesis of β-methylglucoside in a neutral fluid, not taking part in the reaction. This synthesis can be effected by emulsin in aqueous acetone solutions.—E. **Kayser**: Contribution to the study of ropy beer.—Venceslas **Moycho**: Study of the action of ultra-violet light on the ear of the rabbit. The influence of intensity and of intermittent radiations. A continuation of work described in an earlier paper.—Œchsner de **Coninck**: The presence of propionic acid in the secretions of rheumatic subjects. Propionic acid was isolated from the urine. - G. R. **Blanc**: Parasitic typhlitus of the Nandou. The disease appears to be due to a new species of Heterakis, for which the name *H. parisi* is proposed. —Raphael **Dubois**: A micrococcus from the calcareous concretions of tuberculous origin.—J. A. **Samuels**: Cytological studies on the relations existing between the nucleus and the development of crystals in the parenchymatous cells of the perianth of Anthurium.—François **Bochin**: Hydrographical phenomena in the western region of the Paris basin.—Louis **Mengaud**: Contribution to the study of the Wealdian in the province of Santander.—Edmond **Bordage**: The Eocene gulf of Rovan.—Jacques **Deprat**: The geology of Tonkin.—Ph. **Négris**: Contribution to the geology of Greece.—F. **Dienert**: The use of absorbent pits. A reply to a communication of M. Dollfus relating to a means of combating floods in the Paris basin.—A. **Boutaric**: A relation between the atmospheric absorption and the polarisation of light diffused by the sky.

BOOKS RECEIVED.

Life and Evolution. By F. W. Headley. New edition. Pp. xx+272+plates. (London: Duckworth and Co.) 5*s*. net.

Geologischer Führer für Exkursionen im Wiener Becken. By Dr. F. X. Schaffer. III. Teil. Pp. x+167+x plates+map. (Berlin: Gebrüder Borntraeger.) 5.80 marks.

New Zealand. Department of Mines. Geological Survey Branch. Bulletin No. 15 (New Series). The Geology of the Waihi-Tairua Sub-division, Hauraki Division. By J. M. Bell and C. Fraser. Pp. vii+192+plates. (Wellington: J. Murray.)

Java. Zoologisch en Biologisch. Afledering I.-V. By Dr. J. C. Koningsberger. Pp. 254. (Batavia: G. Kolff and Co.) 5 francs.

Single-Phase Commutator Motors. By F. Creedy. Pp. x+113. (London: Constable and Co., Ltd.) 7*s*. 6*d*. net.

Rainfall Reservoirs and Water Supply. By Sir A. R. Binnie. Pp. xi+157+xvi plates. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Report on the Danish Oceanographical Expeditions 1908–1910 to the Mediterranean and Adjacent Seas. Vol i., Introduction, Hydrography, Deposits of the Sea-Bottom. Pp. 269+xx plates. (Copenhagen: A. F. Host and Son.)

Earthquakes and other Earth Movements. By Prof. J. Milne. Sixth edition. Pp. xvi+388. (London: Kegan Paul and Co., Ltd.)

Mathematics, Science, and Drawing for the Preliminary Technical Course. By L. J. Castle. Pp. vi+149. (London: G. Routledge and Sons, Ltd.) 1*s*. net.

The Game of Mind. By P. A. Campbell. Pp. iii+80. (New York: Baker and Taylor Co.) 75 cents net.

Practical Physiological Chemistry. By S. W. Cole. Third edition. Pp. xii+230. (Cambridge: W. Heffer and Sons, Ltd.) 7*s*. 6*d*. net.

Earthwork Haul and Overhaul, including Economic Distribution. By J. C. L. Fish. Pp. xiv+165. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 6*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 1.

ROYAL SOCIETY, at 4.—Election of Fellows. At 4.30.—The Capacity for Heat of Metals at Different Temperatures: Prof. E. H. Griffiths and Ezer Griffiths.—The Transition from the Elastic to the Plastic State in Mild Steel: A. Robertson and G. Cook.—Studies of the Processes Operative in Solutions. XXVIII. The Influence of Acids on the Rotatory Power of Cane Sugar, of Glucose and of Fructose: F. P. Worley.—The Attainment of High Potentials by the Use of Radium: H. G. J. Moseley.—The Decrease in Velocity of α Particles in passing through Matter: E. Marsden and Dr. T. S. Taylor.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. III. Cults of Northern Syria: Prof. J. Garstang.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Use of the Electrostatic System for the Measurement of Power: C. C. Paterson, E. H. Rayner, and A Kinnes.

LINNEAN SOCIETY, at 8.—The Structure of the Wood of East Indian Species of Pinus: Prof. P. Groom and W. Rushton.—Branching Specimens of *Lyginodendron oldhamium*, Will: Dr. Winifred Brenchley.—A Problem in Weismannism: A. C. F. Morgan.—Note on *Sphenopus*

Pixell.—Report on the Arachnida of the Seychelles: S. Hirst.—*Gypsina plana*, Carter: Miss Marjorie Lindsay.—Nitidulæ, Heterocidæ: A. Grouvelle.—Pselaphidæ de l'Archipel des Seychelles: A. Raffray.—Anthribidæ of the Seychelles: Dr. K. Jordan.—Hispinæ from the Seychelles: S. Maulik.

FRIDAY, MAY 2.

ROYAL INSTITUTION, at 9.—Blood Parasites: H. G. Plimmer.

GEOLOGISTS' ASSOCIATION, at 8.—The Farnham Gravel Beds in Relation to Palæolithic Man: H. Bury.

SATURDAY, MAY 3.

BRITISH PSYCHOLOGICAL SOCIETY, at 3.30.—Notes on a Case of Morphomania: Dr. F. Aveling.—Wonder, Fascination, and Curiosity: Prof. Carveth Read.—A New Tachistoscope: Prof. C. Spearman.

ESSEX FIELD CLUB (at the Essex Museum of Natural History, Stratford), at 6.—Annual Meeting.—*Dalyellia diadema*, a Turbellarian New to Britain: H. Whitehead.—Prehistoric Art: S. Hazzledine Warren.

MONDAY, MAY 5.

SOCIETY OF ENGINEERS, at 7.30.—Tidal Waters as a Source of Power: C. A. Battiscombe.

ROYAL SOCIETY OF ARTS, at 8.—Antiseptics and Disinfectants.: Dr. D. Sommerville.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Frontier Work on the Bolivia-Brazil Boundary: Capt. H. A. Edwards.

ARISTOTELIAN SOCIETY, at 8.—The Notion of the Truth in Bergson's Theory of Knowledge: Miss L. S. Stebbing.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Methods and Apparatus used in Petroleum Testing. II. Viscometry: W. F. Higgins.—(1) The Ore Deposits of Hu-Nan and Hu-Peh; (2) Experiments on the Hydrometallurgical Treatment of Slimes: W. R. Schoeller.—Hydrazinel Nitrate: W. R. Hodgkinson.

TUESDAY, MAY 6.

ROYAL INSTITUTION, at 3.—(1) Recent Physiological Inquiries; (2) Equilibrium and the Sixth Sense: Prof. W. Stirling.

ZOOLOGICAL SOCIETY, at 8.30.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. X. Two Species of Tapeworms from *Genetta dongolana*: Dr. F. E. Beddard.—Pacific Salmon: an Attempt to Evolve something of their History from an Examination of their Scales: J. A. Milne.—Note on *Peripatoides woodwardii*, Bouvier: Kathleen Haddon.—Field-observations on the Enemies of Butterflies in Ceylon: J. C. F. Fryer.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Some Recent Work on Post-glacial Geology and Anthropology: Rev. Dr. A. Irving.

VICTORIA INSTITUTE, at 4.40.—The Origin of Life: What do we know of it?: Prof. G. Sims Woodhead.

RÖNTGEN SOCIETY, at 8.15.—Theory and Practice in Ray Therapeutics. Dr. H. Johnson.—Demonstration of a New X-Ray Couch: Dr. Hampson.

WEDNESDAY, MAY 7.

SOCIETY OF PUBLIC ANALYSTS, at 8.—A New Apparatus for Maintaining Constant Temperatures: F. H. Dupré and P. V. Dupré.—The Proportionate Determination of Cocoanut Oil and Palm Kernel Oil in Mixtures: H. R. Burnett and C. Revis.—The Composition of Milk.—H. D. Richmond.—Examination of the Oils from *Manihot ceara* and *Funtumia elastica* and a Comparison of their Properties with those of Linseed and Hevea Oils: Dr. Rideal and L. H. D. Acland.—The Recovery of Iodine from Residues: H. W. Gill.

AERONAUTICAL SOCIETY, at 8.30.—Atmospheric Waves, Eddies and Vortices: Col. H. E. Rawson, C.B., R.E.

ROYAL SOCIETY OF ARTS, at 8.—Life-saving at Sea: A Welin.

ENTOMOLOGICAL SOCIETY, at 8.—Pupal Coloration in *Papilio polytes*, Linn., and the Larval Habits of the Tineid Moth *Melasina energa*, Meyr.: J. C. F. Fryer.

FARADAY SOCIETY, at 8.—(1) A Re-determination of the Electric Modulus of Aluminium; (2) The Density of Aluminium: Dr. F. J. Brislee.—The Potential due to Liquid Contact. III.: Dr. A. C. Cumming and Elizabeth Gilchrist.—Note on the Electrolytic Determination of Copper in Solutions containing Nitric Acid: Elizabeth Gilchrist and Dr. A. C. Cumming.—New Experiments on Colloids: T. A. Coward.—Overvoltage: Prof. J. W. Richards.

GEOLOGICAL SOCIETY, at 8.—The Bathonian Rocks of the Oxford District: M. Odling.—The Petrology of the Kalgoorlie Goldfield (Western Australia): J. A. Thomson.

THURSDAY, MAY 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Various Inclinations of the Electrical Axis of the Human Heart: A. D. Waller.—Trypanosome Diseases of Domestic Animals in Nyasaland. III.: *Trypanosoma pecorum*: Surg.-Gen. Sir D. Bruce, Major D. Harvey, Major A. E. Hamerton, and Lady Bruce.—The Excystation of *Colpoda cucullis* from its Resting Cysts and the Nature and Properties of the Cyst Membranes: T. Goodey.—The Experimental Hybridisation of Echinoids: C. Shearer, W. de Morgan, and H. M. Fuchs.—The Action of Radium Rays upon the Cells of Jensen's Rat Sarcoma: Dr. S. Russ and Dr. Helen Chambers.

CONCRETE INSTITUTE, at 7.30.—Shear and Problems arising therefrom: H. K. Dyson.

FRIDAY, MAY 9.

ROYAL INSTITUTION, at 9.—Life History of a Water Beetle: F. B. Browne.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, MAY 10.

ROYAL INSTITUTION, at 3.—Humphrey Internal Combustion Pumps: H A. Humphrey.

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Explosives: a Synoptic and Critical Treatment of the Literature of the subject as gathered from Various Sources. By Dr. H. Brunswig. Translated and annotated by Dr. Charles E. Munroe and Dr. Alton L. Kibler. Pp. xv+350. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1912.) Price 12*s.* 6*d.* net.

IN this volume Dr. Brunswig attempts to direct the study of explosives from the largely empirical methods of the past into the more definite fields of exact physical chemistry, in which the nature, causes of explosion, and the controlling conditions governing such phenomena naturally fall. For this purpose he has collected the well-known facts (and in many instances those frequently overlooked) and arranged them in a systematic manner.

The earlier sections deal with the general character of explosive reactions, their velocity, pressure, and temperature conditions, the character of the gases evolved, explosion by influence, &c. Judging by most of the literature on the subject, the physico-chemical bearing of these important matters is seldom considered, and Dr. Brunswig's earlier chapters certainly emphasise the necessity which exists for their receiving more consideration, if progress is to be made. As the author points out, "the days of purely empirical progress in the technology of explosives are numbered."

Some comparisons of the energy content of explosives (expressed as the heat of combustion) with ordinary fuels are of interest. While 1 kilogram of liquid petroleum develops 12,000 calories, and average coal about 8000 calories, dynamite (with 25 per cent. kieselguhr) only develops 1300 calories. "Explosives are only technically valuable because they liberate all their energy in a very short space of time." The actual utilisation of this energy, according to the author, by no means compares favourably with that in a high-class engine, such as the Diesel type. The efficiency of such engines is given as 32 per cent. (37 would be a better figure), whilst with most explosives the available energy is calculated to be only 15 to 20 per cent. of the theoretical.

The misleading relative value of explosives of widely different character which may be deduced simply from the heat of combustion, or the product of the gaseous volume and temperature attained (the characteristic product, or potential energy), is evident from the following figures, from tables in the book, when explosive gelatine is taken as 100.

	Comparative value: On calories available	Comparative value: On gas volume × temperature
Nitroglycerin ...	... 96 ...	... 97
Guncotton ...	... 66 ...	... 81
Picric acid ...	... 49 ...	... 61
Black powder ...	... 41 ...	... 17
Mercury fulminate	... 25 ...	... 11

As the author points out, such misleading figures—which place, for example, mercury fulminate below powder—are due to the omission of the velocity with which the reactions take place. In this connection it should be mentioned that in Noble's classical work with modern smokeless powders, this reaction velocity would not be greatly different for the various explosives he dealt with, and the relative potential energy figures would be unaffected.

The second portion of the book, dealing with the characteristics and manufacture of the principal explosives, will convey little fresh information to those already somewhat familiar with the subject. Dr. Brunswig says that he has "refrained from mentioning other material which has become known to him through personal relation with the technique of explosives," and pleads "the restraining influence of industrial discretion," where contradiction exists between literature and personal knowledge of the facts.

In the list of important propellants, brown prismatic powder and amide powder appear as "great-gun powders," and ordinary black powder as a musket powder. It would be of interest to learn who is still employing them for these purposes. Again, M.D. cordite is classed as a musket powder, but is not included in the big-gun powders.

Erosion is one of the most important questions relating to propellant explosives. The author quotes Sivy's statement that one-third of a kilogram of iron is lost with every shot from an efficient 28 cm. gun. The reader might, however, find difficulty in deciding on the primary cause. In one place it is stated that the percentage of nitroglycerin originally present in the earlier ballistites and cordites was reduced (a change intended solely to reduce erosion) because the explosive contained too much nitrogen. It must not be inferred that the true reason for erosion, the high temperatures resulting from the high proportion of carbon dioxide formed, is overlooked, but this primary

cause is certainly confused by other ambiguous statements.

Some interesting results of experiments on the liability of metals to erosion may be quoted. They were carried out in an American steel works by firing a heavy charge in a shell, the base of which was formed of the metal under test with a 4 mm. hole bored through. Martin, tungsten, and nickel steels offered about the same resistance to erosion, 20 per cent. nickel steel was much more easily attacked, whilst manganese bronze failed to stand the action of the highly heated gases.

There are several points of interest in relation to the safety of explosives deserving of mention. In view of the extensive investigations and introduction of new methods of testing the liability of mining explosives to cause ignition of methane-air and coal dust-air mixtures, Mallard and le Chatelier's early observation that a methane-air mixture requires ten seconds to ignite when conducted through a porcelain tube at 650-660° C. is worthy of being recalled. The influence of the duration of the flame, on which Bichel has laid great emphasis, is in such circumstances apparent.

With propellant explosives the unexplained effect which gelatinisation of nitrocelluloses has in decreasing the stability of the finished product, as compared with the ungelatinised parent substance, affords opportunity for speculation and research. Here an apparently simple physical change, leading to consolidation, seemingly unconnected with any chemical change, induces a marked increase in the liability to spontaneous chemical decomposition.

The disaster on the French battleship *Iéna* is but an instance of such decomposition leading to grave consequences. The B smokeless powder, which was credited with being the initial cause, consisted of two parts of insoluble nitrocellulose and one part of soluble, gelatinised by an ether-alcohol mixture. The temperature of the magazine where the 10 cm. cartridges were stored which first fired was extraordinarily high with the refrigerating appliances out of action—estimated between 50° and 60° C. The marked acceleration of decomposition of such powders with rise of temperature is one of their striking features.

The book should be generally welcome as an addition to the already extensive literature on explosives, for, in those parts outside the purely practical, the subject is viewed from an unaccustomed point of view, and different aspects from the orthodox are always valuable. Further, the excellent references and index of authors add appreciably to its value.

J. S. S. B.

NEW BOOKS ON PHYSIOLOGY.

(1) *Human Physiology.* By Prof. Luigi Luciani. Translated by Frances A. Welby. Edited by Dr. M. Camis. With a preface by Prof. J. N. Langley, F.R.S. In four volumes. Vol. ii.: Internal Secretion—Digestion—Excretion—The Skin. Pp. viii + 558. (London: Macmillan and Co., Ltd., 1913.) Price 18*s*. net.

(2) *Le Problème Physiologique du Sommeil.* By Henri Piéron. Pp. xv + 520. (Paris: Masson et Cie., 1913.) Price 10 francs.

(3) *The Chemical Constitution of the Proteins.* By Dr. R. H. A. Plimmer. Part ii.: Synthesis, &c. Second edition. Pp. xii + 107. (London: Longmans, Green and Co., 1913.) Price 3*s*. 6*d*. net.

(1) THE important character of Prof. Luciani's text-book was well recognised by English readers when the translation of the first volume made its appearance. The second volume, which has just been issued, confirms this impression. The subject-matter is treated, as a rule, in an interesting way, pros and cons on disputed points are discussed intelligently, and the work of past researchers, though in the main chiefly interesting to the historian, is presented with great fulness and lucidity. The book will prove a valuable asset to the professed physiologist and to the advanced student.

For the average or junior student one may say at once that the work is scarcely likely to benefit him much. It assumes he already knows almost as much as its veteran author, and the multiplicity of the authorities quoted and the divergent views expressed by them will only lead him into a quagmire of confusion.

The book will be especially welcome, as it brings to the knowledge of English-speaking workers some idea of the energy and fertility of their Italian colleagues. It is naturally these who are most largely quoted. At the same time the preponderance given to Italian work and thought has its disadvantages, especially as one so often notices the omission of important investigations carried out in other countries. This leads in many cases to a very imperfect presentment of certain problems, and in such instances the subject-matter is consequently not complete or up to date. This is especially noticeable in cases where chemistry has played a part in the elucidation of physiological mysteries. Prof. Luciani is a man of great erudition and boundless industry, but the chemical side of physiology is evidently not his strong point.

His account of the physiology of the suprarenal body could not have been written in a more interesting manner, but beyond the mere mention

in a parenthesis of the epoch-making work of Schäfer and Oliver, there is nothing to indicate that it was these workers who founded our knowledge of the physiology of this organ. Adrenaline is referred to as a chemical substance of known composition, but there is no description of its constitution, nor of the success which has attended the efforts which have been made to synthesise it.

The account given of the pituitary is similarly marred by the entire omission of Herring's and Howell's researches, which have thrown so much light on its development, structure, and functions. Nussbaum's work on the kidney is mentioned and dismissed with a shrug because Adami failed to confirm some of his statements. We are not told that Adami subsequently withdrew most of his criticisms, nor of the important recent development of the Nussbaum method in this country, which has shown that this particular means of investigation has proved to be a sheet-anchor in our conception of the mechanism of the renal organs.

So also in the discussion on the absorption of proteins the author's knowledge seems to have stopped short at an epoch when it was believed that proteose and peptones were absorbed as such, and we have many pages devoted to an antiquated description of how these are re-synthesised in the intestinal wall into the blood-proteins. The work of Fischer, Abderhalden, and a host of American workers is passed by without a reference.

Such examples might be multiplied almost to weariness. It would therefore be advisable that if advanced students take this book as their guide it would be well for them not to rely exclusively upon it. They will derive both pleasure and profit from its study, but if they desire the latest and most accurate account of modern views they should supplement it with reading other books which deal rather with the present than with the past.

(2) Dr. Piéron's book on sleep is of quite a different character, for it only treats of one small corner of physiology, and yet he has contrived to write a volume on this subject almost equal in length to the one we have just considered. It, however, resembles Prof. Luciani's in its wealth of references. Some sixty pages are devoted to bibliography alone. This indicates how much has been written, but it also shows how little we really know. If physiologists had satisfactorily solved the intimate meaning of sleep, there would be no need of so much discussion and printer's ink, and the subject might have been discussed in as many lines as there are pages devoted to it. It is only fair to say, however, that the book is a singularly interesting one, and the subject is discussed with that admirable clearness which distinguishes the writings of most French authors. Of all the numerous theories advanced, some chemical, some circulatory, some histological, some psychological, and so forth, the author most inclines to the so-called inhibition hypothesis. The book is entitled a physiological problem, but many pathological or quasi-pathological states are included; thus we have chapters devoted to coma, unconsciousness produced by drugs and other means, fatigue, hypnosis, and others. It will therefore appeal to the students of pathology and medicine as well as to those who make physiology their life-work.

(3) The third book on our list, that by Dr. Plimmer on protein synthesis, is the second edition of a work which has already been favourably noticed in these columns. The mere necessity of a second edition of such a highly technical work is no mean testimony to its excellence. So rapid have been the recent advances in knowledge on this question that the book is very largely a new one, and it is thoroughly up to date. To peruse the original memoirs on which the book is founded is a task which would deter many authors, and certainly the majority of readers. The useful summary Dr. Plimmer has given will relieve the latter class from undertaking such a labour. It would be damning the book with faint praise to say that it is interesting; it is far too technical and packed with facts and formulæ to make it light reading, but to those who want to know the recent developments in one of the most important of the problems of the day to which either chemists or biologists can apply themselves, the book will prove a veritable godsend.

W. D. H.

THE GAS TURBINE AND OTHER ENGINES.

(1) *The Gas Turbine.* By H. Holzwarth. Translated by A. P. Chalkley. Pp. viii+140. (London: C. Griffin and Co., Ltd., 1912.) Price 7*s.* 6*d.* net.

(2) *A Primer of the Internal Combustion Engine.* By H. E. Wimperis. Pp. xiii+143. (London: Constable and Co., Ltd., 1912.) Price 2*s.* 6*d.* net.

(3) *Vapours for Heat Engines.* Including Considerations Relating to the Use of Fluids other than Steam for Power Generation. By Prof. W. D. Ennis. Pp. v+78. (London: Constable and Co., Ltd., 1912.) Price 6*s.* net.

(1) ENGINEERS interested in this very difficult problem are much indebted to Mr. Holzwarth for his ingenuity, to Mr. Junghaus for his support, and to both for their liberality

in making public the results of their labours in this direction up to the present. Though the book is but a small volume of 140 pages, the matter is greatly condensed, and will demand close attention for its full significance to be appreciated.

The essential unit of the Holzwarth gas turbine consists of a combustion chamber into which gas, or hydrocarbon vapour, and air are delivered at a small pressure by a suitable pump through mechanically operated inlet valves; ignition is by high-tension magneto, and the resulting high temperature and pressure combustion products then discharge through a spring-controlled flap valve, *via* a nozzle, to the rotor vanes; having passed the rotor, the gases enter an exhaust pipe, wherein a partial vacuum is constantly maintained by an exhauster. Very shortly after ignition the flap valve is slowly closed by mechanical means, time being permitted for a gust of scavenging air to pass through, thus cleansing and filling the combustion chamber in readiness for the next working charge of vapour, and cooling the nozzle and rotor vanes. The action is thus intermittent, and the design involves three valves in each unit, together with charging and exhausting pumps. In the actual turbine several such units are arranged symmetrically around a turbine wheel or rotor, the continuous speed of which is preserved by the successive impulses thereby imparted to its vanes. As fuels, petrol, kerosene, gas oils, benzol, and even tar oil may be satisfactorily employed.

The book is divided into four sections, in the first of which a theory of the gas turbine is exhibited mathematically by aid of analysis and of entropy diagrams; much of this part is of the nature of a summary of formulæ and results, and cannot be fully appreciated without much reference to other works; moreover, partly on account of difficulties of analysis, but largely from imperfection of the physical data, some of the conclusions reached are of a very conjectural character, and may require substantial qualification after a more extended practical experience. The author considers in detail the several operations of charging, compression, ignition, combustion, expansion, and scavenging; he concludes that the intermittent action used, with the lowest possible temperature of charge prior to ignition, and the largest possible nozzle opening, is essential to economy, and is conveniently realisable in actual design. Data relative to compression are still wanting, and the investigation given proceeds largely upon assumptions suggested by experience and general knowledge; in the Holzwarth combustion unit it is not practicable to compress to any extent before ignition, but the author is persuaded that satisfactory turbine efficiencies are attainable at much lower compressions than are usual in reciprocating engines.

An interesting section of the work is that dealing with the utilisation of the exhaust heat; by aid of a "regenerator," sufficient heat is said to be recoverable to work the charging and exhausting apparatus.

The construction and details of the actual turbine are described, and the text is illustrated b[y] many well-drawn and clearly executed figure[s]. The gas turbine is as yet in its infancy, and [it] would be unfair at the present time to compa[re] it with the modern reciprocating high-efficien[cy] engine; in the last section of the book test resul[ts] are given, together with copious diagrams a[nd] tables. Progress is continuing, and further e[x]perimentation is needed, and will be carried out b[y] the able author and his business colleague.

The translator is to be congratulated on h[is] work; the text is in such good and clear Englis[h] as to betray no suggestion of its German origi[n]. The book is well printed and illustrated, and fro[m] all points of view is a welcome and valuab[le] addition to the literature of the problem.

(2) This is an excellent elementary text-boo[k] on the internal combustion engine, with speci[al] reference to the small petrol engine, and forms [a] suitable introduction to the larger work by th[e] author on the same subject; though succinctl[y] presented, the matter is never obscure. A bri[ef] historical notice is succeeded by an account o[f] the leading facts of the theory of heat and th[e] fundamental formulæ of the ordinary theory o[f] perfect gases. The desirable feature appears o[f] a limited use of easy differentials, the severa[l] steps of the reasoning being given in full so tha[t] the student should experience no difficulty in fo[l]lowing the argument to its conclusion; tha[t] nebulous quality, entropy, is also dealt with intelli[gi]gibly, and a useful account is given of indicator[s] and indicator diagrams. The difficult subject o[f] explosion pressures is treated in the light of th[e] results obtained by the Gaseous Explosions Com[]mittee, the variability of specific heat with tem[]perature being suitably emphasised. This is fol[]lowed by descriptions and large sectional view[s] of actual typical engines, including the Diesel an[d] semi-Diesel types, together with illustrations an[d] an account of uncooled and cooled pistons an[d] valves, and a short note on Aëro engines.

Chapter vi. treats more fully of fuels, both liqui[d] and gaseous, including alcohol and benzol, an[d] the principle of the gas producer; next som[e] engine details, notably ignition and carburation are shortly described; finally, a chapter is devote[d]

to the testing of engines, and reference is made to the author's accelerometer; we should like to have found a more detailed account of this very ingenious and useful instrument. Examples are introduced in various portions of the work for the student's exercise on points of theory, and answers to many of these are given at the end of the work, which concludes with a useful index. Both in matter and style the book is much better than many of the small elementary treatises that have already appeared, while the printing and illustrations leave nothing to be desired. Altogether this forms an attractive and useful little work which will prove of real assistance to the student in the earlier portions of his course.

(3) In this tract of 78 pages are conveniently collected data as to the physical properties of special interest to the engineer of several liquid substances, including alcohol, chloroform, carbon tetrachloride, ether, ammonia, sulphur dioxide, acetone, and carbon disulphide, together with steam tables. The collection should prove useful for purposes of reference; the author uses British thermal units and Fahrenheit degrees of temperature, and his figures will thus be immediately available to the great majority of British engineers to whom it is still difficult to think in metric and centigrade units, notwithstanding the theoretical advantages claimed for the metric system.

In appendix i. the formula for chloroform ($CHCl_3$) is incorrectly given as C_2HO_3, and "carbon chloride" is used for carbon *tetrachloride*; as there are several carbon chlorides it seems desirable to distinguish clearly which is referred to.

The work is well got up, and contains numerous tables and diagrams relative to the substances dealt with, together with a discussion of the limits of efficiency attainable theoretically with the several liquid fuels considered.

OUR BOOKSHELF.

Percentage Compass for Navigators, Surveyors, and Travellers. By J. C. Fergusson. (London: Longmans, Green and Co., n.d.) Price, unmounted, 2*s*. 6*d*. net; mounted on linen, 3*s*. 6*d*. net.

MR. FERGUSSON has apparently just discovered what everyone knew before, viz., that at the angle of 45° the natural sine is equal to the natural cosine, or the one is 100 per cent. of the other, and, being obsessed with the idea that the one great object in life is to work out percentages, he has taken the trouble to find the values of the natural cosines when the natural sine has any percentage from 1 to 100 to those natural cosines. He then divides the compass circle into octants, and each octant into 100 unequal parts, or percentages, and states that by the use of these percentages Traverse tables are no longer required.

What Mr. Fergusson has really done is to make a new Traverse table where the natural cosine, arranged in percentages in a circle outside the compass, has to be multiplied by the percentage course steered to obtain the natural sine.

At present both natural cosine (diff. of latitude) and natural sine (departure) can be obtained from the ordinary Traverse tables for every degree of the compass and for any radius between 1 and 300.

Not only does Mr. Fergusson give a roundabout way of obtaining a result which can be readily extracted from the Traverse tables, but he also seems to think that the natural cosines and sines on a circle, the zero of which points to the magnetic north, will give the difference of latitude and departure by utilising the percentages of the octants on a compass card marked by his method. These, it is scarcely necessary to point out, can only be ascertained when the zero of the circle points to the true north, or each course steered has been corrected for the magnetic variation and any local disturbance caused by a vessel's magnetism.

An Essay on Hasheesh. Including Observations and Experiments. By Victor Robinson. Pp. 83. (New York: "Medical Review of Reviews," 1912.) Price 50 cents.

IT is difficult to regard this booklet as a serious contribution to medical literature. It consists of about four score small, narrow pages, about half of which are occupied by an account of the hallucinations and rhapsodies experienced by the author when under the influence of the drug *Cannabis sativa.* What the precise value of these observations is it is impossible to discover. It is no more practicable to subject them to rational or systematic analysis than to attempt to find reason or method in the incoherent ravings of delirium. The particular manifestations induced by Indian hemp must, of course, largely depend upon idiosyncrasy, temperament, antecedent and accidental conditions, and a host of predetermining and fortuitous causes, and must therefore vary from individual to individual and differ, too, in different circumstances even in the same individual.

The only valuable section of the book is the short digest of the little that is known from prior work concerning the therapeutics and chemistry of hasheesh.

Life and Evolution. By F. W. Headley. Pp. xx+272. Second edition. (London: Duckworth and Co., 1913.) Price 5*s*. net.

THE present does not differ greatly from the first edition, which was reviewed in the issue of NATURE for March 7, 1907 (vol. lxxv., p. 434). Mr. Headley has re-written a few pages, corrected occasional inaccuracies, and replaced several unsatisfactory illustrations by better. He has also, in the light of new facts which have become available since the book appeared first, modified some of his views.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Proposed Tropical University.

THE proposal to create a tropical university which has been put forward in the columns of NATURE and elsewhere is one which requires careful scrutiny and calls for a clear appreciation of the real issues involved.

It seems at least open to question whether the advocates of the scheme really contemplate a new university, or whether they are not rather thinking of a college or institute of university rank, the work of which should be somewhat intimately associated with the promotion of the material prosperity of the great agricultural interests that are growing up in the tropics. Such a college, in addition to the function of inducting men into the various branches of tropical agriculture, should serve, if properly staffed and organised, as a centre for the dissemination of current information on matters pertaining to the industrial needs of the community, in so far as agricultural problems are concerned. For this purpose it is essential that facilities for field and other experiments should be fully provided, and if the site were suitably chosen the college would prove an invaluable training ground, not only for the population resident within its immediate geographical area, but for others also, and especially perhaps for Europeans, about to engage in agriculture in any part of the tropics. Various places have been suggested as possible sites, and there is much to be said in favour of the West Indian proposal. Easy access from Europe, as well as the variety of soil, climate, vegetable products, &c., are all points in its favour, whilst the fact that no British institution of the kind desired exists in that region is a defect which would thus be repaired. Furthermore, the possibility of securing a considerable range of advantages within a relatively small geographical area is of itself a distinct gain, for it could be more economically worked than a similar institute in a large continental area, where things are on a larger scale, quite apart from limitations imposed by a continental climate, which cannot be ignored.

Accepting for the moment the desirability of founding a college of the kind indicated, the danger that lurks in the scheme would almost certainly be found, in practice, to consist in a desire to see immediate results which would be convertible into a cash value by the planters. In order to ensure success, it is absolutely essential that a wise and far-sighted policy should guide the destiny of the institute. Agricultural problems, and especially tropical problems, are seldom simple, and while immediate practical objects need not, and should not be lost sight of, the college would fail to justify its creation if it were to exist for these purposes alone. It must, while not neglecting the practical training of students in tropical agriculture, also include within itself, as a vitally essential part, a body of first-rate scientific investigators and teachers, who will be able to seize upon problems and work them out. There must be no attempt to limit their work to the economic questions of the moment, for in cramping the spirit of investigation lies the way of throttling material progress.

Such a staff would, of course, cost money, and often the return might seem to be slow in coming, but it is impossible to over-estimate its importance. Indeed, unless a proper staff can be provided, the scheme is not worth pursuing, for the most that could then be hoped for would be a mere technical institute —a sort of edition *in parvo* of current planting practice, veneered over by a fallacious appearance of scientific equipment.

Now an institute such as is here foreshadowed would greatly gain by connection with leading institutions in this country. Science is growing apace, and particularly those branches of it which especially touch on agriculture. And, however able the staff, it could not hope to escape from the disadvantages inherent in a separation from the main clearing-houses of scientific thought. Some sort of association, then, with home institutions, such as the University of Cambridge and the Imperial College of Science and Technology, for example, could not fail to be of advantage to all concerned. An association of this kind ought to be a real and not a merely nominal one, for only in this sense could it serve any useful purpose and provide for an interchange of knowledge and for the stimulation of ideas. Arrangements might perhaps be made for enabling suitable students of the college to visit this country and be received for a time in the home institutions, and *vice versâ*.

Such a college, conceived and maintained on generous lines, would develop into a valuable asset to the Empire, and would exert a powerful influence in furthering the interests and objects of tropical agriculture within it.

But the question of an insular tropical *university* is a very different one. There are perhaps already more than enough universities, and it is difficult to see how it would be possible to justify the foundation of another in the manner that has been suggested, —quite apart from the very considerable outlay that would be necessarily involved.

Moreover, a centre of real university learning, and still less of culture, can scarcely be created by the stroke of an administrative pen, and it would, in any event, be compelled to seek its justification in the existence of a population large enough and able in other respects to utilise the advantages the university ought to be in a position to confer. And it seems open to inquire whether a mere fraction of the financial resources which would be needed for the more ambitious project might not amply suffice to enable everyone of marked ability to enter an existing university elsewhere, if he (or she) were otherwise unable to do so. There would be many disadvantages inseparable from a small insular university, and it is scarcely necessary to dwell on them here. For the present it may suffice to remark that a second-rate university is not worth its upkeep, whilst a properly staffed and equipped one would demand very considerable funds, and not only so, but other claims, difficult to meet, would also have to be satisfied.

The further one reflects on the matter the weaker does the case for the establishment of the university, and the stronger the claims for the foundation of an agricultural college, appear. Almost all the arguments which can be urged against the first proposition can be used in support of the latter. But it may be that after all a substantial agreement already prevails amongst the majority of those who are advocating the scheme, and that an agricultural college of university rank is really what is desired.

J. B. F.

The Mountains and their Roots.

IN NATURE of February 27, p. 703, you honoured me with a review of my recent paper on the origin of the Himalaya Mountains. During thirty years of residence in these mountains I have continually been

confronted by the geodetic problems which they present. The highest geological authorities express doubts as to how mountains have been upraised, and geological theorists differ widely.

In my recent paper I suggested, with diffidence, the hypothesis that the long belt of Indus-Ganges alluvial plains was concealing a deep crack in the subcrustal shell of the solid earth, and that the Himalaya mountains had been crumpled up by the opening of this crack in the solid globe.

When a large mass of heated rock, or ore, or glass is cooling, its surface is apt to crack; we never see the core of any such mass shrink away from the outer shell and leave the outer shell too large and unsupported, as is often assumed to be happening in the case of the earth.

Are geologists quite sure that the earth's outer shell has not been cracking, and that the cracks are not hidden from our sight by silt? Would not the cracking of a solid globe provide a sufficient mechanical force to elevate mountains?

The earth's rotation is slowing down; the equatorial protuberance of rock is constantly straining to move polewards.

Throughout the whole length of the Indus-Ganges belt of plains earthquakes are frequently occurring, and what can be causing these earthquakes, if not the splitting asunder of the solid globe beneath?

At both extremities of the Indus-Ganges belt deep narrow submarine cañons exist extending far out to sea; they are known to sailors as "swatches." What are these swatches, if not the surface indications of a subcrustal crack?

In the review in NATURE my hypothesis is dismissed without any specific objection to it being raised. I am not wedded to it, and I should welcome its dismissal, if I thereby learnt its errors. But I am disappointed to see it rejected merely because my critic has himself accepted the "floating crust" hypothesis.

The reviewer has accepted as true the hypothesis of the Rev. Osmond Fisher. According to this hypothesis the solid crust of the earth is of limited thickness and floats upon a liquid magma of greater density. This assumption of a liquid substratum appears to me to be opposed to the views of the great majority of geological writers. So far as I am able to judge, the weight of the evidence seems largely in favour of a solid globe.

Furthermore, Mr. Fisher has to assume that as the central core of the earth cools down, the outer crust is left unsupported owing to the core's contraction ("Geology of India," R. D. Oldham, p. 471). This assumption of a cooling core contracting away from its shell seems to me to be more difficult to justify than the assumption of a cooling shell becoming too small for its core.

But let me descend from these great assumptions to actual geodetic figures.

Mr. Fisher assumes that the crust floats in the dense liquid, just as ice floats in water. Each mountain rising from the upper surface of the crust has a corresponding protuberance extending downwards from the lower side of the crust. The buoyancy of a protuberance suffices to support the weight of the corresponding mountain above it.

If h=height of a mountain, and if d=depth to which its protuberant root extends downwards into the liquid, then, according to Fisher, $d=9{\cdot}6\times h$.

Now let me apply this hypothesis to the mountains of India. All these mountains are assumed to be buoyed by subcrustal protuberances of lower density than the magma, but the protuberances extend downwards to different depths, which are proportional to the several mountain heights.

Mountain	Height of mountain above crust = h	Depth of protuberance below crust = d.
	Miles	Miles
Tibet plateau	3	29
Himalayan range	4	38
Vindhyas	0·6	5

Let us suppose a plumb-line to be suspended near the foot of a mountain, and let us suppose that the mass of this mountain is compensated by a deficiency of density underlying it below the crust. If that deficiency of density be wholly concentrated near sea-level, it will entirely compensate the attraction of the mountain mass, and the plumb-line will hang vertically. But if that deficiency of density be distributed to a great vertical depth, it will not compensate the mountain's attraction, first, because of its greater distance in depth from the plumb-line, and secondly, because its resultant action is more inclined to the horizontal.

If a mountain (Himalayan) is four miles high, and if its protuberance extends downwards to a depth of thirty-eight miles, the geodetic observer would report:—"There is distinct evidence of compensation, but the compensation is by no means complete."

If, however, a mountain (Vindhyan) is 0·6 mile high, its compensation would take place within five miles of the crust, and the observer would report:—"The compensation is here more complete than in the case of the higher mountain."

Similarly a pendulum observer at a station (Himalayan) two miles high will (according to the Fisher hypothesis) not find the same degree of compensation as he will at a station (Vindhyan) half a mile high. The underlying deficiency of density will in each case have a retarding effect on the pendulum, but at the Himalayan station the deficiency reaches downwards nineteen miles into the liquid, whilst at the Vindhyan station the deficiency only extends five miles downwards.

According, then, to the "floating-crust" hypothesis our plumb-line and pendulum observers should find the attraction of small mountains more completely compensated than the attraction of high mountains. But what are the results of actual observations? Both the pendulum and plumb-line observers find the attraction of the Himalayas to be largely compensated, whilst the Vindhyan mountains are not compensated at all. Actual results of observation are in direct opposition to the "floating-crust" hypothesis.

Mr. Hayford has stated that the "floating-crust" hypothesis is not true for the United States of America ("Figure of the Earth and Isostasy," p. 164), and in my opinion the evidence is sufficient to show that this hypothesis is not true for India.

S. G. BURRARD.

Surveyor-General's Office, Dehra Dun, March 29.

As an officer of the Survey of India, employed for many years in determining deflections of the plumb-line and variations in the intensity of gravity, I was interested to find in the article which appeared under this heading in NATURE (No. 2261, vol. xc., February (27) reference to the hypothesis suggested in 1904 by the Rev. O. Fisher as to the nature of mountain compensation, and the statement that this hypothesis goes far to explain the deflections of the plumb-line observed at the foot of the Himalayas and in the Gangetic plain. The article states that, according to Mr. Fisher's hypothesis, "the crust is of uniform density, the isostatic compensation being obtained by a variation in thickness," and that, on this hypothesis, Mr. Fisher "finds that the attraction of the visible range combined with the negative attraction of the

downward protuberance should give a northerly deflection of about 24″ at the foot of the hills, of about 2″ at sixty miles away, and a southerly deflection of about 2″ at the farther edge of the plains. These results appear to be in very fair accord with the observations. . . ."

This statement is liable to convey a wrong impression. We are given to understand that the effects of the visible mountain mass and the downward protuberance are sufficient to explain the observed phenomena. The facts stated below will show how far this is correct. In addition, the article referred to makes no mention of an important feature of the Rev. O. Fisher's hypothesis. We are not told that part of the deficiency of mass which compensates the visible mountain range is supposed to be, not under the range, but under the plains. Mr. Fisher's hypothesis is not one of simple isostatic compensation, but involves the horizontal displacement of part of the compensating deficiency.

Mr. Fisher's investigations were published in *The Phil. Mag.* of 1904, in an article which your reviewer suggests has been overlooked by Col. Burrard in his paper, "The Origin of the Himalaya Mountains: a Consideration of the Geodetic Evidence." As regards the overlooking of Fisher's investigation, it will be sufficient to point out that it was included, at Col. Burrard's own request, as an appendix to Professional Volume xviii., "Astronomical Latitudes and Deflections of the Plumb Line," published by the Survey of India in 1906. Also on p. 5 of Col. Burrard's paper under reference, we find the hypothesis of horizontal displacement of compensation discussed and rejected.

Before discussing Fisher's investigation, let me state the facts that require explanation. At the eastern end of the Himalayas are found northerly deflections of 46″, at a point about five miles north of the foot of the slope, and of 1″ at a meridional distance of twenty miles south of the slope. The variation of deflection in the twenty-five miles is 45″. In the central Himalayan region we find 38″ north at a few miles north of the foot of the slope and 5″ south at a meridional distance to the south of 112 miles, the variation here being 43″ in 112 miles. In the western Himalayas, in the meridian of Dehra Dun, deflections occur of 31″ north at the foot of the hills, and of 1″ north at a meridional distance of fifty-six miles. Here the deflections change by 30″ in fifty-six miles.

Thus, in a strip of country from thirty to 100 miles wide, lying immediately at the foot of the Himalayan slope, there is found a very rapid variation in the deflection of the plumb-line in the meridian. But while the variation is large, the average deflection over this tract is small, rather less than 20″ north. The observed variation of deflection is greater than that due to the visible Himalayan mass considered entirely uncompensated, and it might seem that we must admit this complete want of compensation of the hills in combination with a deficiency under the plains. Here, however, we are opposed by the evidence of the deflections themselves. Though we find that the observed variations of deflection are greater than if compensation did not exist, the observed deflections themselves are much smaller.

Now, Mr. Fisher, in his paper of 1904, investigated the deflections at three points on the meridian of Kalianpur. One of these lies at the foot of the Himalayan slope, and Mr. Fisher correctly takes Dehra Dun as representing this point. A second point, sixty miles from the slope, is represented by Kaliana, while the third point is 293 miles from the foot of the slope. This point is considered to represent Kalianpur. Kalianpur, however, is about 420 miles, measured on the meridian, south of Dehra Dun. The point 293 miles from the foot of the slope corresponds more nearly with a point between Usira and Kesri.

The observed phenomena which Mr. Fisher had before him were a change of deflection, amounting to 30″, in the sixty miles between Dehra Dun and Kaliana, and an average deflection in this interval of 16″; a change of 43″ between Dehra Dun and Kesri, with an average deflection of 16″.

Considering Fisher's investigation first from the mathematical point of view, we find that the theoretical plumb-line deflections are calculated for three points only, while his formulæ involve several unknowns, thickness of crust, crustal density, ratio of crustal to subcrustal density, the degree of compensation which, taken into consideration with the ratio of densities, determines the depth of the mountain root, the deficiency of mass underlying the plains and the area over which this is distributed. Obviously more than one set of suitably adjusted values of these unknowns will bring the formulæ into accord with the observed facts. The agreement, if such agreement did exist, of Fisher's calculated quantities with the observed deflections would be interesting, but it would not prove the correctness of his hypothesis.

Mr. Fisher calculated the theoretical deflections on two hypotheses, neglecting the effects of sphericity. In the first the visible mountain range is compensated by a deficiency of mass vertically below it. The results of this calculation are exhibited on p. 17 of *The Phil. Mag.* for January, 1904. The theoretical change of deflection over the sixty-mile interval is found to be 15·5″ in a plane at right angles to the range, or about 12″ in the meridian, with an average deflection of about 6·5″ in the meridian. These calculated quantities of 12″ and 6·5″ correspond to the observed 30″ and 16″. In calculating the effect at 293 miles from the slope, evidently an error has crept into Mr. Fisher's computations. The residual deflection is stated to be away from the mountain range. This is an impossibility where sphericity is neglected. The positive attraction of the visible mass and the negative attraction of the compensating root only become equal at an infinite distance from the mass. In a later paper, dated April, 1904, other figures are given for the deflection at the south of the plains, making the theoretical difference between deflections at the foot of the slope and at the south edge of the plains about 17″, with an average deflection of 10″ against the observed 43″ and 16″.

It is evident that "the attraction of the visible range, combined with the negative attraction of the downward protuberance," fails to give theoretical effects in accord with the observations.

Mr. Fisher then modified his first hypothesis, and it is this modification that has been lost sight of by the reviewer of Col. Burrard's paper. Mr. Fisher now supposes the mountain mass not supported solely by the root immediately beneath it, but partly by the effect of the crust below the Siwalik rock of the plains being depressed by 15,000 ft. into the substratum. A third factor is thus brought into operation, namely a deficiency of mass underlying the plains. It is true it may be claimed that the deficiency is considered as part of the isostatic compensation of the visible Himalayan mass, and that Fisher's system does not introduce a third entity, but merely implies an irregular distribution of compensating masses. The whole deficiency equivalent to the surface excess, instead of lying directly below the latter, is, in part, displaced horizontally to below the plains. But the elimination of part of the deficiency below the visible range has the effect of altering the variation between deflections at the foot of the slope and at the south edge of the plain by only 2″, whereas the differential effect of this

deficiency of mass, when transferred to the subcrust under the plains, is 8″. The significant fact is not so much the reduction of deficiency below the mountain range as the location of a deficiency under the plains between the foot of the slope and the southern station of observation. In Fisher's hypothesis this is the important feature which brings about a more rapid variation of deflections than follows from the assumption of simple compensation.

The results of the calculation upon the second hypothesis give 20″ as the variation of deflection between Dehra Dun and Kaliana, with an average deflection of 12″, against the observed 30″ and 16″. The calculated variation and average deflection for the interval between the foot of the hills and the southern edge of the plains are, respectively, 24″ and 10″, the observed values being 43″ and 16″. The differences between Fisher's quantities, based on the second hypothesis, and those observed, approach, on an average, 35 per cent. of the observed values.

Both hypotheses, that of simple and that of general compensation, fail to give results in accord with observation, when Fisher's numerical values are used. In his second hypothesis his assumption of a three-mile depression of the crust is inadequate. As pointed out by Col. Burrard in his paper, to explain Himalayan deflections by a hidden synclinal, we must assume the latter to be seventy to eighty miles wide and six miles deep under Siliguri, seven miles south of the foot of the slope, and two miles deep under Jaljaiguri, thirteen miles south of Siliguri, the rock composing the synclinal basin to have a density of 2·7, and the sediment filling the synclinal to have a density of 1·9. As Col. Burrard says, it is doubtful whether the density of sediment, when under a pressure of a vertical column six miles high, would remain as small as 1·9; any increase in its value will require the depth of the supposed synclinal to be increased.

In connection with Fisher's investigation, there is an interesting point. Putting aside his computed figures, we see that both he and Burrard agree in considering that the observed facts cannot be explained by only the visible Himalayan mass and its vertically underlying root. Both investigators are forced to conclude the existence of a third factor, a source of negative attraction under the plains at the foot of the hills. Fisher prefers to adopt the idea of deficiency extending under a relatively wide belt of the crust due to the depression of the latter into the liquid substratum, the outer surface of this depressed tract being brought up to sea-level by the deposition of the Siwalik beds and alluvium. This hypothesis leads to the assumption of very doubtful values of some of the unknown quantities, as has been shown above. Burrard's hypothesis differs from Fisher's in that he would localise the deficiency in a rift in the crust subsequently filled in by deposits.

H. M. COWIE.

Dehra Dun, U.P., India, April 3.

SURELY Col. Burrard and Major Cowie have misread the review; it did not dismiss Col. Burrard's speculations, but pointed out that he had himself dismissed, with what appeared to be inadequate examination, an hypothesis which seemed fully capable of explaining the facts. The sentence which has elicited their letters was intended to refer solely to the memoir under review, and had no application to other publications by the same author. The memoir did not, in fact, contain any detailed investigation of an hypothesis which, if tested numerically and in its completeness, appears to be at least as capable of affording an explanation of the facts as that propounded by Col. Burrard. The reviewer may point out that the limited amount of space at his disposal compelled the omission of reference to many points of which he was well aware, and had fully considered, but in view of the publication of these letters he may be permitted to amplify the argument of the paragraph in the review which has called them forth.

Mr. Fisher's investigation assumes an isostasy by flotation, and, what is an almost inevitable consequence, that the flotation is not confined to the area of the range, but that, as an iceberg has generally an under-water extension helping to support the visible mass, so the lighter "crust" under the plains is borne down into the denser "substratum" or "subcrust" by the weight of the mountain range. This interpretation is in accord with the evidence of the pendulum, which shows that the defect of gravity under the mountains is continued under the plain, and only gradually decreases with increasing distance from the range; it is also in accord with conclusions drawn by the Geological Survey long before the observations of variations in the force of gravity and of deflection of the plumb-line in the neighbourhood of the foot of the hills were published, and the constants used by Mr. Fisher, so far as they are special to the Himalayas, were taken from these reports.

According to the hypothesis, a station near the edge of the hills, such as Kurseong, would be affected (1) by the positive attraction of the visible masses; (2) the negative attraction of the "root" or downward thickening of the "crust" into the "substratum"; (3) by the negative attraction of the submerged portion of the "crust" under the plains, replacing denser "substratum"; and (4)—though Mr. Fisher did not separately consider this—by the negative attraction of the alluvial deposit of the plain, the mean density of which is less than that of average rock. Of these (1) is the same whatever hypothesis of isostasy is adopted; (2), it appears from Mr. Hayford's investigation of the effect of an isostasy produced by compensation limited to a ten-mile stratum, between twenty-five and thirty-five miles depth from the surface, would somewhat increase the deflection at a station situated on the edge of the hills (*e.g.* Kurseong), and make but little alteration at a station twenty or thirty miles out in the plain (*e.g.* Jalpaiguri); (3) and (4) would both produce their maximum effect at a station situated like Kurseong, and have comparatively little influence at one situated like Jalpaiguri. Here we have three separate corrections, all working in the same direction, and all attaining their maximum at the same station, and it is not inconceivable that together they might afford an explanation of the peculiarities noticed by Col. Burrard.

It is obviously useless, at the present stage of our knowledge, to enter into detailed calculations of an imaginary range, but some approximate calculations made by the reviewer indicate that the increase in the difference of deflection as between Kurseong and Jalpaiguri due to (2) would be of the order of 4″, to (3) of the order of 8″, and to (4) of not less than 9″, or a total increase in the calculated difference of deflections amounting to more than 21″, as compared with Col. Burrard's unexplained anomaly of 30″. These figures have no value, except as indicating that there is another hypothesis, besides that of the "rift," which would account for a change in the amount of deflection near the foot of the range, of the same character and order of magnitude as that actually observed.

It must be added that this explanation can only be taken as applying to the Himalayas; the conditions in the Vindhya are entirely different and require to be considered apart.

THE REVIEWER.

PIANOFORTE TOUCH.

WHEN the editor of *Popular Mechanics* submitted a list of modern inventions to a referendum to select the "seven principal wonders of the modern world," the piano-player and player-piano were conspicuous by their absence from the long collection, although they possess quite as many features of scientific interest as many of the inventions actually submitted. These mechanisms have, moreover, failed, for some not very obvious reason, to form the subject of discussion in scientific and technical journals where frequent mention is made of such proprietary inventions as motor cars, gramophones, kinematographs and the like. Yet a number of subjects for scientific discussion may be suggested in connection with piano-players. The psychologist, for example, will notice that after a very little experience the performer does not consciously move his regulator to play faster or slower; but he unconsciously plays the notes at the exact instants that he thinks of them quite as much as if he were striking the keys with his fingers.

The attempt to compare pneumatic playing with finger playing in the matter of "touch" lands us in a very difficult problem of dynamical acoustics which has not received so much attention as it deserves from physicists. We are told that the piano-player cannot reproduce the clear singing *pianissimo* of the finger pianist, that there is a certain element wanting which only the human fingers can supply. What is this element? A piano-player can be played as softly or as loud as is desired, it allows full use of the pedals, and a slight jerk of the time lever enables the performer to "linger on a note" as well as an ordinary pianist. But still, we are told, the "touch" is not the same, and if a few notes are played from the music roll and then played with fingers, a certain difference in the quality of the tone often appears noticeable.

Now the quality of a note, apart from its actual loudness, depends on the relative intensity of the fundamental tone and its several harmonics, and we are thus led to inquire into the question how far the harmonics of a pianoforte note are capable of being intensified or reduced independently of the fundamental tone.

It is obvious that great differences in quality are produced by the use of the loud pedal, and the old-fashioned soft pedal which shifted the hammer off one of the strings and caused a softer part of the hammer to strike the others had an equal effect; moreover, the singing qualities and delicate harmonics are quite destroyed by shutting up a piano and covering it with ornaments. But even when other conditions are kept constant, differences are noticeable according to whether the same note is struck with a sharp blow or a heavy pressure, and we are thus led to the important question: *Are the intensities of the fundamental tone and its harmonics functions of one variable only, or are they functions of two or more variables?*

Now upon this point I find that a great disagreement of opinion exists. Many piano-makers in this country hold to the single-variable hypothesis on the ground that when the hammer is striking the strings it is disconnected from the keys; if this were not the case the note would be "blocked." On this hypothesis the striking velocity of the hammer constitutes the single independent variable. The single-variable theory is not inconsistent with the possibility that the character of a note may vary according to its loudness; this only requires that the intensities of the various components shall be different functions of the same variable instead of being multiples of the same function.

Other people will tell us that if it were possible to produce differences in the quality of a pianoforte note, they would be too small to be appreciable.

In Germany, on the other hand, I am informed that great importance is attached by teachers of the pianoforte to differences in the manner of applying pressure to the keys. During the small interval of time that the key is being depressed, this pressure is an arbitrary function of the time, or, if preferred, of the displacement, the form of the function depending on the action of the fingers and in particular on their elasticity, and the German method distinctly assumes the existence of a relationship between the form of this function and the quality of the note sounded.

Neither Helmholtz's nor Kaufmann's theories afford an explanation of the "two-variable" hypothesis. I believe other papers have been published dealing with this question, both experimentally and theoretically, and I hope the present article will be the means of eliciting information on the subject. It is evident that such investigations have not become widely known among physicists. From the point of view of applied mathematics, the difficulty of the problem consists in finding fundamental assumptions which lead to the desired conclusions, and are at the same time consistent with the structural conditions as they exist in the pianoforte. Two possible explanations suggest themselves:—

1. Although the hammer is at a slight distance from the wires in its position of *equilibrium*, it may still be acted on by some impressed force while touching the string, owing to the elasticity of the connections.

2. The stem of the hammer is flexible and capable of independent vibration, so that the circumstances of the impact may depend on the bending set up in projecting the hammer.

I am now investigating the equations of motion based on these two alternative assumptions, but the problem is a very difficult one, and it seems desirable to obtain further experimental evidence before any final conclusions can be reached.

For some time past I have obtained results with a piano-player which exhibit conspicuous discrepancies from what one would expect on the single-variable theory, and a good deal of care has been exercised in ascertaining that these effects

are not due to mere imagination. My experiments have been so far directed towards the question as to how far differences of dynamical touch can be made to produce effects that can be noticed by an ear not specially trained to observe them. The apparatus used in these experiments consists of a horizontal lever fixed in front of a piano-player of the usual standard type; the short arm of this lever is connected by a wire passing over pulleys, or by some other connection, with the small auxiliary bellows of the player, and acts directly on it, the usual spring being removed. The lever carries a sliding weight by which the collapsing tension of the bellows can be regulated. When the bellows collapses it closes a kind of throttle valve in the mechanism, thus cutting the air off

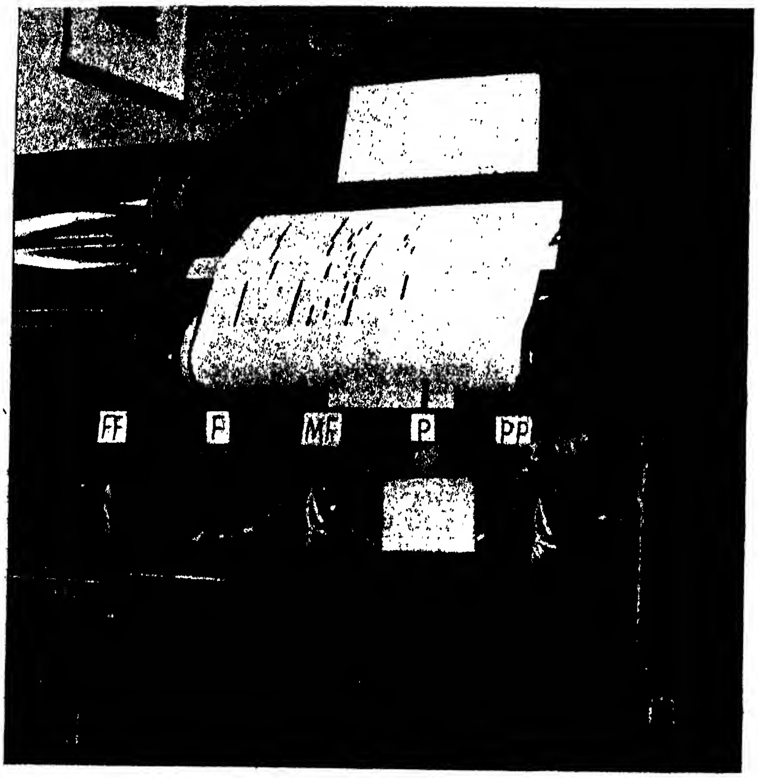

FIG. 1.—Apparatus (provisionally protected) for controlling the touch of a piano-player.

and producing an action similar to that effected by a short sharp impulse applied to the pianoforte keys. By increasing the load, by shifting the weight towards the end FF, a heavier sustained pressure is produced.

When the same passage is played first with the weight at PP and then with it at FF, a noticeable difference is observed. The loudness can be made about the same in both cases by suitably altering the pressure on the pedals, but in the former position the result is a brilliant "metallic" effect in which the treble notes stand out conspicuously, while in the latter position soft, mellow tones are produced in which the bass notes predominate.

The differentiation between bass and treble parts of chords is not necessarily inconsistent with the single-variable theory, since the hammers are of different mass in different parts of the scale, and therefore undergo different accelerations when the same variable force is applied to them. This dynamical differentiation is more satisfactory than the popular mechanical arrangement for controlling the two halves of the keyboard, as it involves no hard and fast dividing line.

In a passage involving chords it is impossible to separate the effects due to differences between the notes of a chord from any possible differences between the harmonics of the notes, and therefore it is necessary to choose a solo passage in order to effect a decisive test. I have shown such tests to a good many people; a few notice either no differences or only very slight differences. On the other hand, it is very surprising to find how many people notice conspicuous differences, and those who are most successful in detecting them are often people with no ear for music and no previous musical training. In most cases I ask them to describe what they observe without previously preparing them. It is thus evident that the dynamical effects dependent on these differences of touch, so far from being negligible, must have a marked influence on the impressions formed by a large proportion of both the musical and unmusical people who attend a first-class pianoforte recital.

Something more than merely sliding a weight is necessary to approximate to the rendering of a good pianist, who can vary his action on the keys from one note to the other. To effect the same result the lever must be controlled by hand as well, being pressed or jerked from above or below practically in an unlimited variety of ways. An almost infinitesimal touch of the finger will often cause a particular note to ring out brilliantly. In the commercial player the performer has to depend mainly for these effects on his feet. Now not only are feet much less sensitive than fingers, but the effects are so modified by the elasticity of the various springs that these latter have a predominating influence in governing the touch, and a considerable effort on the part of the performer often produces only a slight difference in the result.

A remarkable instance of how a trifling cause may greatly modify pianoforte tones was shown in a recent demonstration at the Physical Society when the effects were observed to be rather loud and harsh. In this case a copper wire was used for the connection between the lever and bellows instead of one of steel. On trying the copper con-

nection at home the effects were identical with those shown at the Imperial College.

In this country little attention is paid to pianoforte touch, owing, probably, to the use of boxed-up pianos covered with jangling ornaments, when sufficient volume of sound has to be obtained by violently hammering the keys and bobbing down the pedals through harmonics and discords. Moreover, the average pianoforte pupil has too much to do with learning execution to trouble about "touch," and very few professionals produce variations in the quality of their notes at all approaching the possible maximum. It is not surprising, therefore, to find widespread belief in the single-variable theory. At the same time, I do not consider it possible to overlook the numerous results of independent observation which are inconsistent with that theory.

It is much to be hoped that the increasing popularity of the player-piano will lead to increased interest in the more scientific aspects of piano-playing.

The explanation of the acoustical effects produced by the modern pianoforte is probably a dynamical problem of considerable complexity, depending on a number of causes, many of which have hitherto been neglected. It is important that not only should attention be directed to any investigations bearing on the matter which have commonly been overlooked, but that further experiments should be carried on with the object of better localising the apparent discrepancy which exists between theory and observation.

G. H. Bryan.

AGRICULTURAL EDUCATION.

For many years past technical education of a more or less efficient kind has been provided for the majority of our leading industries, but for some reason or other our greatest industry of all, and that on which indirectly all the others depend, has been left with scarcely any provision at all. It may be that this is due to the fact that agriculture is the nurseling of one Government Department and education of another, and that under our rigid red-tape-bound system, agriculture has no dealings with education. It gives peculiar pleasure, therefore, to note that this system shows signs of amendment, and one of the firstfruits of reform is seen in a memorandum recently issued by the Board of Agriculture and Fisheries to local authorities in England and Wales offering grants from the newly-established development fund towards the furtherance of technical instruction in agriculture and horticulture.

The grants promised are intended to aid (1) in the establishment of advisory councils to be set up in each county or group of counties for the purpose of reviewing, governing, and co-ordinating or initiating schemes for providing higher agricultural education and educational experiments in connection therewith; (2) in the provision and maintenance of buildings and lands for farm schools and farm institutes, at which young agriculturists and others whose daily business is connected with the land may obtain scientific and practical instruction in the technicalities of their art. At each of these schools and institutes it is intended that a highly efficient staff shall be maintained to give short courses of instruction in summer and winter suited to the requirements of the district, also to conduct experimental and research work, and to which agriculturists can apply for advice in cases of difficulty. The grants for farm schools and institutes may be partly annual where new or additional work is being undertaken.

Somewhat stringent conditions are laid down for the administration of the grants to prevent their being applied to the relief of the ratepayers in those districts where such work has already been begun, but that these districts may not be discouraged, the proportion of the grant to the actual expenditure may vary from 50 to 75 per cent., having regard to the financial burden hitherto undertaken by each local authority in this direction.

A covering letter directs attention to the leading provisions of the memorandum, and gives, amongst other things, the Board's ideas with regard to the appointment and duties of a responsible official or organiser in each county or division. The success or otherwise of the scheme will depend very largely upon whether the right man is or is not found for this important post, and as suitable men cannot at the present time be very plentiful, the authorities will be well advised not to insist too rigidly on the paper qualifications of the candidates, but to judge each on his merits, past performances, and experience in agricultural education and organisation.

The scheme outlined contains the germ of an excellent system, but its success or failure will depend largely upon the skill and tact with which it is developed. When the curricula and atmosphere of our rural elementary and secondary schools have been reformed so as to complete the scheme, and the inherent prejudices of the farming community have been overcome, we may hope for a good return for the money spent, but we must not look for abundance of fruit before the tree has had time to take root and expand its branches. Progress will doubtless be slow, and much patience, skill, and trouble will have to be expended before a crop may be looked for.

William Aldridge.

NOTES.

At the meeting of the Linnean Society on May 1 Prof. Hermann von Vöchting was elected a foreign member, and the president announced that it had been decided to award the Linnean medal to Prof. Adolf Engler.

The council of the Manchester Literary and Philosophical Society has nominated Sir Thomas H. Holland, K.C.I.E., F.R.S., to represent the society at the twelfth International Congress of Geology, to be held in Toronto in August next.

A message from the Wellington correspondent of *The Times* on May 1 says:—Miss Procter's mission

to New Zealand to urge the establishment of a solar physics observatory has been successful. Mr. Cawthron, a citizen of Nelson, has offered to give the 10,000*l.* to 12,000*l.* which is estimated to be the sum required.

THE annual autumn meeting of the Institute of Metals will this year, under the presidency of Prof. A. K. Huntington, be held on the Continent, for the first time since the institute's formation in 1908. It will take place in connection with the Ghent International Exhibition, the dates fixed being ugust 28-30. Among many important papers to be communicated will be the report of the corrosion committee.

AT a meeting of the Mansion House Committee of the Captain Scott Fund on Monday, May 5, the Lord Mayor announced that the combined funds, including that of *The Daily Telegraph*, amounted to 56,129*l.*, of which 12,493*l.* had been assigned for supplementing the Government provision for the relatives, 1848*l.* towards discharging the liabilities incurred by the expedition and the publication of the scientific results, and 6112*l.* for a memorial, leaving the allocation of the balance, 35,675*l.*, to the discretion of the committee. A committee was appointed to consider and report upon the form the memorial should take.

As announced already, a joint meeting of the Institution of Electrical Engineers with the Société Internationale des Electriciens will be held in Paris on May 21-24. The following papers will be discussed at the meeting:—High-tension continuous-current traction, M. Gratzmuller; single-phase traction, M. Latour; the electrification schemes of the Chemin de Fer du Midi, M. Jullian; the electrification of the Paris suburban lines of the State Railway, A. N. Mazen; railway electrification problems in the United States, H. Parodi; petrol-electric motor trains, J. B. Damoiseau; long-distance transmission of electric energy (continuous current), J. S. Highfield; long-distance transmission of electric energy (three-phase current), M. Leblanc; automatic telephony: application of mechanical devices to the assistance of manual operating in telephone exchanges, W. Slingo.

THE Historical Medical Museum, organised by Mr. Henry S. Wellcome, which is to be opened in London towards the end of June next, will include some objects of particular interest. An important exhibit in the science section will be a large collection of the original apparatus used by Galvani in making his first experiments in galvanism in the eighteenth century. Other exhibits will be a collection of votive offerings for health, ancient microscopes, and optical instruments, amulets and charms connected with English folk medicine, early medical medals and coins from the Græco-Roman period, and early manuscripts and medical books.

ARCHÆOLOGISTS will welcome the announcement that the famous prehistoric camp, known as Maiden Castle—Maidun meaning "Hill of Strength"—near Dorchester, has been, at the suggestion of the King, purchased by the Duchy of Cornwall, and will now be carefully preserved. The camp dates from Celtic times, and formed a shelter for cattle during tribal raids rather than a military fortress. Water was supplied from a Neolithic dew-pond on the summit of the plateau, and the palisading kept at bay wolves and other enemies, while the cattle were left in charge of a few women and children. The cunningly arranged entrances to the camp supply a remarkable example of primitive methods of defence.

AT the annual general meeting of the Marine Biological Association of the United Kingdom, held in the rooms of the Royal Society on April 30, the following officers and members of council were elected for the year:—*President*, Sir Ray Lankester; *Chairman of Council*, Dr. A. E. Shipley; *Hon. Treasurer*, Major J. A. Travers; *Members of Council*, E. T. Browne, L. W. Byrne, Dr. W. T. Calman, Prof. H. J. Fleure, Prof. F. W. Gamble, Sir Eustace Gurney, Commander Campbell Hepworth, Prof. J. P. Hill, E. W. L. Holt, Prof. E. W. MacBride, H. G. Maurice, Dr. E. Schuster, G. W. Smith, Prof. D'Arcy W. Thompson; *Hon. Secretary*, Dr. E. J. Allen. The following governors are also members of council:—G. P. Bidder, the Earl of Portsmouth, Sir Richard Martin, the Hon. N. C. Rothschild, Prof. G. C. Bourne, Dr. A. E. Shipley, Prof. W. A. Herdman.

AT the annual general meeting of the Institution of Civil Engineers, held on Tuesday, April 29, the result of the ballot for the election of officers was declared as follows:—*President*, A. G. Lyster; *Vice-Presidents*, B. H. Blyth, J. Strain, G. R. Jebb, A. Ross; *other Members of Council*, J. A. F. Aspinall, J. A. Brodie, W. B. Bryan, Col. R. E. B. Crompton, C.B., J. M. Dobson, Sir H. F. Donaldson, K.C.B., E. B. Ellington, W. H. Ellis, W. Ferguson, Sir Maurice Fitzmaurice, C.M.G., Sir J. P. Griffith, Dr. C. A. Harrison, W. Hunter, H. E. Jones, Sir Thomas Matthews, Dr. W. H. Maw, C. L. Morgan, B. Mott, A. M. Tippett, Sir Philip Watts, K.C.B., W. B. Worthington, Dr. Dugald Clerk, F.R.S., R. S. Highet, Dr. E. Hopkinson, F. Palmer, and H. N. Ruttan.

THE annual meeting of the Iron and Steel Institute was held on May 1-2, when the Bessemer gold medal for 1913 was presented to Mr. Adolphe Greiner by the president, Mr. Arthur Cooper. In making the presentation, the president said Mr. Greiner was in 1864 appointed chemical engineer, and in 1887 general director of the steel works of Messrs. John Cockerill, Seraing, Belgium. He was responsible for the introduction into Belgian iron and steel practice of the basic processes, and has been to the front in the utilisation of blast furnace and coke oven gas. The Andrew Carnegie gold medal for 1912 was presented to Dr. J. Newton Friend. The annual dinner was held on the evening of May 1. Mr. R. Elliot-Cooper, president of the Institution of Civil Engineers, spoke of the importance of the work of standardisation of materials, in which the institute has been engaged. Sir Alexander Henderson in the course of a speech remarked that science has done more for the iron and steel industry than for any other. The president of the institute said the growth of the iron and steel industry is seen in the fact that during the life of

the institute the production of steel has grown from 600,000 to 60,000,000 tons per annum.

It would appear from the recent annual report of the Decimal Association that the General Medical Council has announced that all measures and weights in the new British Pharmacopœia, including those referring to dosage, will be in the metric system, and that in order to facilitate the use of the work by medical men, the equivalents for dosage will also be given in the Imperial system. Further progress is also reported in connection with the adoption of the metric carat of 200 milligrams as an international unit for the sale of diamonds and precious stones. Owing, no doubt, to the steady advance made by this unit on the Continent, the views of the trade in this country with respect to it appear to have undergone considerable change recently, and to be now generally in favour of the legalisation of the metric carat. It is confidently expected that steps will be taken very shortly by the Government to issue an Order in Council legalising the metric carat, as well as a series of multiples and submultiples of that unit. The effect of this legislation will be to render the present arbitrary and unrecognised carat illegal and to bring the weights and balances used by merchants and dealers for the sale of precious stones by weight under the purview of the local inspectors of weights and measures. A law has recently been passed in Belgium making the use of the metric carat obligatory in that country, and it is anticipated that a similar step will be taken at an early date in the United States, and possibly also in Russia.

We understand that the Easter vacation season, just concluded, at the Port Erin Biological Station, has probably, taken all round, been the most successful one yet held. The number of senior students and of post-graduate researchers at work in the institution during March and April was above sixty. *Amphidinium operculatum*, the minute brown dinoflagellate which was found for the first time in Britain at Port Erin a couple of years ago, and has kept on occurring since from time to time in vast quantities, was present in abundance during the greater part of April, and was the subject of some interesting experiments and observations. The marine plankton was abundant during the greater part of the vacation, and the catches showed, early in April, the spring diatoms making their appearance in great numbers—at first round the coast on both east and west sides of the island; and not appearing out at sea (*e.g.* at the five-mile station) until a week or so later. Unusually large quantities of floating fish eggs seemed to be present in the tow-nets out at sea (the species have not yet been identified, nor the exact numbers in the hauls estimated), and the results in the fish hatchery attached to the biological station have been exceptionally favourable. The hatching work is still in progress, spawning is not quite finished, so final figures cannot yet be given, but it looks as if this year might be a record one in fish-hatching. By April 24 more than eight and a half millions of plaice eggs had passed into the hatching boxes, and above seven millions of hatched fry had been distributed out at sea.

At a meeting of the Society of Engineers (Incorporated), held on Monday, May 5, a paper on tidal waters as a source of power was read by Mr. C. A. Battiscombe, the object of the paper being to direct attention generally to the commercial possibilities of hydro-electric installations in the British Isles, more particularly with regard to the use of the tides. After some introductory remarks in reference to tidal intervals and the range of neap tides, the author pointed out that in this connection the head of water available for actuating turbines cannot exceed one-third of the range of minimum tides. An outline was given of the arrangements proposed for the constant maintenance of a working head, by means of a chamber for the turbines, connected by valves to the tidal way and to three reservoirs in which the tidal water may be impounded. It was claimed that the utilisation of the tides for power purposes presents few engineering difficulties so far as principles are concerned, but that the real difficulty lies in the question of cost, and therefore in the choice of the site and in the design of the structural details. The author concluded by insisting on the importance of regarding the supply of fuel as a matter that concerns the whole nation: that the demand for combustible fuel is continually increasing, and that coal being practically the only fuel found in England, it would be mere folly to neglect any other available source of energy whereby the present rate of consumption of coal may be sensibly reduced. It was submitted that not only can the tides be utilised as a constant source of power, but that, taken in conjunction with the power that could be derived from fresh-water rivers, their utilisation would be a great gain to the commercial and industrial interests of the United Kingdom.

The majority of the papers read before the first International Eugenics Congress, held in London in July, 1912, were published at the beginning of the congress in a volume entitled "Problems in Eugenics." Some, however, were received too late to be included therein, and these, together with a report of the discussions which took place at the congress and the speeches which were delivered at the inaugural banquet, have now been published in a supplementary volume ("Problems in Eugenics," vol. ii.; London: The Eugenics Education Society, 1913, pp. 196). In the preface Major Leonard Darwin directs attention to the fact that an international eugenics committee has been established on a permanent basis as a result of the congress. The primary object of this committee, which will meet in Paris next August, is to settle questions connected with the future assembly of eugenics congresses, but it is hoped that it may also fulfil the useful function of a clearing-house for information on eugenic matters.

Those who are prepared to accept the view that many, or all, megalithic monuments were designed for the purpose of astronomical observations will be interested in an elaborate paper by Dr. Marcel Baudouin, entitled "Le siège d'observation de Chergiroux à l'Ile d'Yeu (Vendée)," published in vol. iii., sixth series, parts 5 and 6, of the *Bulletins et Mémoires de la Société d'Anthropologie de Paris* for

1912. The learned author has discussed the question with much care and learning, and though some may still hesitate to accept his conclusions, his communication deserves the attention of all who are interested in the astronomical aspect of megalithic monuments.

THE attention of students of African ethnology may be invited to an important paper, "Notes on the Geographical Distribution of the Hottentot and Bantu in South Africa," by Mr. W. H. Tooke, published in part v., vol. ii., of Records of the Albany Museum of Grahamstown. The cradle of the Hottentot race he believes to have been the region now occupied by the Hamitic tribes—Berbers, Gallas, Somali, and Masai. But there are mixed races containing negro, Semitic, and Caucasian elements, and the problem remains whether any of these tribes are derived from a prototype of which the Hottentot is evidently, from close conformity to persistence of type, the present representative. He groups the Bantu into four divisions—inland, including the Makalanga and the Bechwana; coastal, the Baronga or Tekeza, and the Zulu-Xosa or Zulu-Kaffir. The movements of these groups are intricate and obscure, but the information collected by Mr. Tooke will help towards a scientific solution of these tangled problems. The importance of the study of stone implements in the same region was urged in his lecture, delivered on February 29, before the African Society by Prof. Henry Balfour, on the earliest inhabitants of South Africa.

To the April number of *The Geological Magazine* Mr. R. B. Newton contributes a note on the fossils in the Pennant collection, recently presented to the British Museum (Natural History) by Lord and Lady Denbigh. These include about a thousand specimens, some of which were described and figured by Pennant himself. A selection has been placed on exhibition in the geological department.

THE extent to which the native fauna is disappearing in Victoria may be inferred from the following paragraph relating to the Darby district in the March number of *The Victorian Naturalist*:—"Only a few years ago the koalas, or native bears, were numerous, and could be seen here at any time. Wallabies, dingoes, and the introduced hog-deer were also common, but are now replaced by the fox."

IN the Bulletin of the American Museum of Natural History, vol. xxxii., art. 2, Mr. R. J. Coles records a method of obtaining embryos of large rays. Having observed that female rays appeared to have expelled their embryos in their struggles when taken in nets, the author resorted to the plan of jumping into the water as a seine containing a ray was drawn into the shallows, stabbing the fish with a knife in the back of the head, and then holding on to the knife-handle with one hand, and plugging the vent with the other. The fish was then dragged ashore, when the young would be ejected on the sand. The author then describes, with illustrations, the embryos of several species, and also adduces evidence to show that there is a regular northward summer migration of certain tropical species of rays along the Atlantic coast of North America.

IN an article on the late Prof. Alpheus Hyatt and his principles of research, published in the April number of *The American Naturalist*, Dr. R. T. Jackson emphasises the importance of these researches in respect to the phylogeny and mutual relationships of invertebrates. Stages in development, more especially post-embryonic, were a favourite subject with Hyatt, who inculcated the law that the development of the individual is an epitome of that of its group. He also insisted on the importance of a due recognition of parallelism in development, and originated the theory of acceleration of development, as well as directing attention to senile degenerate development. In conclusion, the biographer expresses the belief that in the future "Hyatt will be looked on as the master-mind who pointed out the methods by which to ascertain the true phylogenetic relations of invertebrate organic forms."

THE first part of vol. cv. of the *Zeitschrift für wissenschaftliche Zoologie* contains three papers of considerable interest to embryologists. The first, by Theodor Baumeister, deals with some early stages in the development of the hedgehog. As this animal is sometimes regarded as the oldest living mammal it has already received a large amount of attention at the hands of embryologists, but the present memoir serves to fill an important gap in our knowledge. The second, by Eva Krüger, treats of the reproduction and gametogenesis of the nematode *Rhabditis aberrans*, n. sp., while the development of a more familiar nematode, the well-known fresh-water form, *Gordius aquaticus*, claims the attention of N. Th. Meyer. The segmentation of the egg in the species last-named has been worked out in detail, and the figures are sufficiently convincing. The process of gastrulation, however, appears to take place in a very remarkable manner. The mesenchyme is stated to be formed by an early unipolar immigration, while the alimentary canal arises from two opposite invaginations which meet and fuse together to form a tube, the hinder of the two forming both midgut and proctodæum. The proboscis arises as a second invagination of the anterior end. The author himself appears not quite to be convinced as to the correctness of his account of the formation of the alimentary canal.

AMONG the most recent publications of the Department of Applied Statistics, University College, London, is an investigation into the mortality of the tuberculous after sanatorium and tuberculin treatment, by Mr. W. Palin Elderton and Mr. Sidney J. Perry. The data from which they worked consisted of records of 3000 cases from the Adirondack Cottage Sanitarium, provided by Dr. Lawrason Brown, of smaller numbers from Scottish sanatoria, provided by Dr. Rest and Dr. Guy, and of particulars of cases dating from 1845 to 1870, from the case books of Dr. Austin Flint, which serve as a guide to the mortality of the consumptive in America in pre-sanatorium days. The most interesting of the conclusions arrived at is stated by the authors as follows:—"There is no evidence in the mortality shown from the data before us to prove that tuberculin as compared with ordinary sanatorium

treatment appreciably lengthens the life of the consumptive. If the use of tuberculin had the very marked results claimed by some of its supporters we should have anticipated more definite evidence of its effect on mortality."

A recent memoir by Capt. R. T. Wells on dysentery in Hazaribagh Central Jail (Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, No. 52) contains a number of important data bearing on the question of the relation of amœbæ to the causation of dysentery. From this, as well as from other recent investigations, it is very clear that great care must be taken to distinguish clearly between harmless contamination-amœbæ and the pathogenic amœbæ which are the true cause of the disease. Contamination-amœbæ can be cultivated from fæces, tap-water, and other materials by planting them on Musgrave's medium; their cysts are air-borne, and readily gain access to fæces or specimens of pus, however carefully collected, or to any material planted on Musgrave's medium contained in Petri dishes. The true dysenteric amœbæ differ in their microscopic characters from the contamination-amœbæ, and they do not live more than a few hours after discharge from the body, whether transferred to Musgrave's medium or not. The failure to distinguish between these two types of amœbæ has led in many cases to very erroneous conclusions being drawn.

To *Symons's Meteorological Magazine* for April Mr. R. C. Mossman contributes the second of his interesting papers upon Southern Hemisphere seasonal correlations, showing that in the month of May a pronounced opposition exists between the barometric pressure at Stykkisholm, Iceland, lat. 65° N., and Laurie Island, South Orkneys, lat. 61° S. The corrected mean pressure at these two places for the month in question, for the years 1902–11, was respectively 29·91 and 29·32 in. An examination of the barometric data at other places shows that in South America, south of about lat. 47°, the pressure departures are in harmony with those at South Orkneys and South Georgia; but data from intertropical and other regions, *e.g.* the Azores, United States, &c., show indefinite results. The author therefrom concludes "that the dominating factor influencing these May pressure variations in the North and South Atlantic is to be found in the polar regions." As to why the striking differences obtain only in the month of May no explanation is offered. Some interesting notes are also made relating to the variations of wind circulation accompanying the differences of pressure in the extreme South and far North Atlantic.

The February number of *Lěss* (*The Forest*) contains articles on the influence of forests on the soil, climate, salubrity, &c., questions already much discussed, and on the modifications caused by man in the distribution of birds. Some birds frequent human habitations to build nests on house roofs, or to obtain food, especially in winter. Wading birds have been driven away by the draining of marshes, and the destruction of woods has deprived certain species of their natural nesting-places, while the fields and meadows which have taken their place have attracted other species. Instances are given of the effect of these changes in Russia.

During the solar eclipse of April 17, 1912, determinations of magnetic declination were made by a number of observers in order to detect any direct action of the eclipse on the magnetic state of the earth. The general verdict was that the effect, if it existed at all, was very small. Dr. S. Kalinowski, of Warsaw, however, directed attention in the October, 1912, number of *Terrestrial Magnetism* to the decided difference in the declination curves obtained by him during the eclipse, and at the same hours on the preceding and following days. The normal increase in the westerly declination was replaced by a small decrease followed by a rather rapid increase. Dr. Kalinowski pointed out that the same effect was exhibited in a less marked degree in the curves obtained at Beuthen, but that the Potsdam curves did not show it. In a letter to the editor of *Terrestrial Magnetism*, published in the March, 1913, number, Dr. S. van Dijk states that the curves obtained during the eclipse at De Bilt, Holland, show an effect of the same character as that found by Dr. Kalinowski.

Messrs. Williams and Norgate inform us that in the advertisement of some of the volumes in the Home University Library, announced in last week's issue, "An Introduction to Mathematics" was, through an oversight, attributed to the Hon. B. Russell in place of Mr. A. N. Whitehead, F.R.S. The volume is correctly advertised in the present issue.

OUR ASTRONOMICAL COLUMN.

The Spectra of Nova Geminorum.—In the publications of the Allegheny Observatory of the University of Pittsburg (vol. iii., No. 3) Mr. F. C. Jordan gives a description of eighteen spectrograms of Nova Geminorum (No. 2). The first of the series of photographs was secured on March 16, when the bright lines were strongly developed on the plate, and the absorption lines a little less so, and the last on April 14, when no absorption lines were detected at all. The author gives tables of the wave-lengths determined, and a series of intensity curves. He mentions the curious fact that with regard to the H and K absorption lines the weighted means of the velocities deduced from them yield a curve which follows to some extent the light variations of the nova, the velocities being positive when the star is brighter and negative when it is fainter. Mr. Jordan suggests that it would be very desirable to examine the velocity determinations from plates secured at other observatories, and for this and other points of view he would place all the plates he secured at the disposal of any astronomer or institution that may decide to undertake such a discussion.

Another paper of importance in connection with this nova is that printed in the Monthly Notices of the R.A.S. (vol. lxxiii., No. 5, p. 380). The authors, Prof. H. F. Newall and Mr. F. J. Stratton, describe a detailed study they have made of the spectrum of the nova on March 15, and they come to the conclusion that the absorption lines are for the most part identical with the lines in α Cygni, and to a small percentage in γ Cygni; or, in other words, the nova spectrum of that date was an enhanced-line spectrum. The

authors refer to the previous work of Sir Norman Lockyer at South Kensington, who showed that in the case of Nova Persei its bright-line spectrum was composed for the most part of α Cygni, or enhanced lines. Thus the origins of most of the nova lines at this stage of its history will now be considered as more definitely settled. The paper is accompanied by an excellent plate showing the nova spectrum and comparison spectra.

RADIAL VELOCITIES OF STARS WITH THE PRISMATIC CAMERA.—Some time ago Prof. E. C. Pickering suggested a means of determining the radial velocities of stars from prismatic camera photographs by inserting in the optical train a medium which produced a sharp absorption line in the stellar spectrum. Mr. R. W. Wood found out that the absorption line of neodymchloride at λ4273 A.U. in a weak solution was of prominent sharpness. Prof. Schwarzschild has now used this filter in connection with an objective prism, the instrument being a Zeiss triplet of 150 mm. aperture and 1494 mm. focal length, and a prism of the same aperture giving a dispersion from Hγ to K of 10·3 mm. He placed the cell a few millimetres in front of the photographic plate, the former being about 8 mm. in thickness, and containing a weak solution, the proportion being 1 to 6. In *Astr. Nachr.*, No. 4646, he gives an account of the results he secured, using the star α Coronæ borealis, the spectrum of which is not very favourable for the research, as the lines are hazy, though the orbit is well known. At least four spectra near each other were taken on the plate, and photographs were secured on eighteen evenings. Prof. Schwarzschild describes in detail the methods of measurement and reduction, and states that the probable error of the mean of six spectra in an evening is ±5·7 km./sec., and the probable error of a single spectrum ±13 km./sec. He points out that Mr. Jordan, with a photograph taken with a slit spectroscope, obtained probable errors of 4·2 to 5·5 km./sec., according to the kind of plate used, and Mr. Cannon a value amounting to ±5·4. The observations corroborate Jordan's period of 17·36 days.

METEORITE FROM KANSAS.—A reprint from the Proceedings of the U.S. National Museum (vol. xliv., p. 325) contains an account of a newly found meteorite from near Cullison, Pratt County, Kansas, by George P. Merrill, head curator of geology of the National Museum. The stone is described as having struck the earth in December, 1902, but it was not found until 1911. Mr. Merrill was thus confronted with the doubt as to whether the stone was the one actually seen to fall, but he found that a thin section indicated the meteoritic nature of the stone at once. Besides showing special interest from the diversity of the chondritic forms which it carried, another feature was a somewhat indistinct wavy banding visible only on a polished surface of a section. The paper, besides giving illustrations of the stone as found and polished surfaces, contains chemical and mechanical analyses of the stone, and the following is the composition of the stone in bulk, omitting percentages of substances less than unity:—

	Per cent.		Per cent
Silica	35·30	Soda	1·80
Alumina ...	4·24	Sulphur ...	2·18
Ferrous Iron ...	8·38	Nickel	1·80
Magnesia ...	23·63	Iron	21·27

ROYAL ASTRONOMICAL SOCIETY OF CANADA.—The January–February number of the Journal of the Royal Astronomical Society of Canada (vol. vii., No. 1) contains much interesting reading, and attention is directed especially to two communications. The first is the address of the president of the society, Prof. L. B. Stewart, delivered at the annual meeting, and has for its title, "The Structure of the Universe." In this be brings together most of the more important recent researches relating to this subject, including such investigations as deal with star streams, proper motions of separate groups, absorption in space, &c. The second article is a delightful account of Mr. John A. Brashear's visit to the home of Dr. Thomas Dick, the Christian philosopher and astronomer. Mr. Brashear came over in 1911 for the fifth centenary celebration of St. Andrews University, and after listening to the opening addresses, as he says, "I could not resist the temptation to slip away" and make a visit to Broughty Ferry, near Dundee, the home of Dr. Dick. Mr. Brashear is full of enthusiasm of the reception he received at the hands of the present owners, and brings together some very interesting notes relating to episodes in Dr. Dick's career; numerous illustrations accompany his communication.

THE ERUPTION OF THE KATMAI VOLCANO, ALASKA, ON JUNE 6, 1912.

IN *The National Geographic Magazine* for February of the present year there appears a very interesting account of the eruption of Katmai, in Alaska, which commenced on June 6, 1912. The Katmai Volcano (7500 ft.) is one of ten or twelve more or less active volcanoes known to exist in the Alaskan peninsula, though probably a still greater number occur in the adjoining Alaskan islands. The report is furnished by Mr. G. C. Martin, who was dispatched by the National Geographic Society of Washington to collect information as soon as the news of the eruption arrived by telegraph. This report, which is illustrated by a map and numerous photographs, shows that the outburst resembled in all its main features that of Krakatoa in 1883, though, happily, owing to the very sparse population of the district, the damage done was comparatively small, and no human lives were lost. No lava-streams are recorded as having been seen, but the eruption, which included three outbursts of excessive violence within two days, consisted in the discharge, first of pumice, and afterwards of dust of gradually increasing degrees of fineness. In the sea, twenty miles from the volcano, floating pumice was accumulated to such an extent that men could walk upon it. At Kodiak, 100 miles from the volcano, dust fell, causing complete darkness for sixty hours, and accumulated to a general depth of 10 to 12 in. Roofs were broken down by the weight of this dust, and houses wrecked by the avalanches of it which descended from the hills. Dust was recorded as having fallen 900 miles away, and if vessels had been in those seas it would probably have been noticed much farther off. Probably great changes were produced in the volcano itself, for one observer declared that half the mountain was gone.

This report is followed in the same journal by an article from the pen of Dr. C. G. Abbot, the director of the Astrophysical Observatory of the Smithsonian Institution, Washington. From observations made by himself in Algeria, where he happened to be at the time of the Katmai eruption, and from communications he received from Mount Wilson, in California, Mount Weather, in Virginia, and other localities in different parts of the globe, he infers that a similar world-wide diffusion of the fine volcanic dust took place as was observed in the case of the Krakatoa eruption, and he discusses the question, "Do Volcanic Explosions Affect our Climate?"

THE SPECTROSCOPE IN ORGANIC CHEMISTRY.[1]

SOMEWHAT more than half a century ago, while engaged, with the assistance of Faraday, in preparing experiments for a Friday evening discourse in this institution, Stokes observed that the spectrum of the electric light extended to five or six times the length of the visible spectrum when he employed prisms and lenses of quartz instead of glass. This extension occurs at the violet end of the spectrum, and consists of rays of high refrangibility, to which the eye is insensitive, but which can be made apparent by means of a fluorescent screen.

At the time of this discovery, and in the years immediately following it, attention was being directed to the absorption of light by coloured solutions, and to the possibility of identifying coloured substances by the number and position of the dark bands in the spectrum of light transmitted through their solutions. Stokes saw that by his discovery of the extension of the spectrum beyond the visible region, this method of investigation might be applied to colourless as well as to coloured substances. In a paper communicated to the Royal Society in 1862, he says:—"Having obtained the long spectrum above-mentioned I could not fail to be interested in the manner in which substances—especially pure, but otherwise imperfectly known organic substances—might behave as to their absorption of the rays of high refrangibility." He proceeded, therefore, to study the action of various organic solutions on the ultra-violet rays, and found that the mode of absorption generally was so constant and so characteristic that by this single property many substances could be identified.

While Stokes was engaged in these researches, Prof. William Allen Miller was simultaneously at work in the same field, and Stokes left the further development of the subject in his hands. Miller improved the method of observation by substituting a photographic plate for the fluorescent screen, but he failed to "trace any special connection between the chemical complexity of a substance and its diactinic power." Struck by this fact, W. N. Hartley—now Sir Walter Hartley—commenced a systematic investigation of the whole subject, and it is to his researches, extending over a period of more than thirty years, that we owe, not only most of the knowledge which we now possess of the relation between the structure of organic substances and the action of such substances on the ultra-violet rays, but the elaboration of the convenient and elegant methods by which such investigations are now conducted.

The light derived from an ordinary source of illumination, such as an electric lamp, consists of waves of all degrees of refrangibility, and its spectrum shows a continuous band of colour ranging from red to violet. The limits of this visible spectrum lie between the wave-lengths 7600 and 3900.

If now, instead of the electric light or other ordinary source of illumination, we employ the light emitted by one of the metals when raised to a high temperature, the spectrum is seen to consist of a series of lines of different colours and intensities lying within the same limits as the visible spectrum. But there are rays beyond the red end of the spectrum and rays beyond the violet end which excite no sensation of luminosity in the eye. By allowing the spectrum to fall upon a screen which has been coated with a fluorescent substance, such as sulphate of quinine or a salt of uranium, these rays are rendered visible for a short distance beyond the violet. But it is only when we replace the glass apparatus, with which we have hitherto been working, by a quartz prism and lenses, and substitute a photographic plate for the eye, that the full extent of the spectrum beyond the violet is revealed. This is the ultra-violet region—the region which Stokes opened up to investigation, and it is with the behaviour of organic substances towards the rays of this part of the spectrum that we have mainly to do this evening.

FIG. 1.—1 Spark spectrum of nickel and iron. 2. The same, after the light has passed through quartz 10 mm. thick. 3. Crown glass 0·13 mm. thick. 4. Crown glass 0·33 mm. thick. 5. Window glass 1·62 mm. thick.

When light is transmitted through a coloured solution certain rays are absorbed, and dark bands corresponding to these rays appear in the spectrum. The importance of these bands as a means of distinguishing coloured substances has long been recognised, and, as we have already seen, considerable progress had been made with their study fifty years ago. As the bands in this case are in the visible spectrum, no special means are required for their observation.

But when we extend this method of investigation to colourless substances we are dealing with phenomena which lie hidden from the unaided eye, and our investigations are necessarily carried out with the help of photography.

The instrument employed in the study of absorption spectra consists of a spectroscope in which the eye-piece of the telescope is replaced by a camera. The

[1] From a discourse delivered at the Royal Institution on Friday, April 4, by Dr. J. J. Dobbie, F.R.S.

photographic plate is set at such an angle as to brin all the rays emanating from the source of light into focus at its surface after they have passed through the resolving prism, and for this purpose it is necessary that the plate should have a very slight curvature. The prisms and lenses of the apparatus are made of quartz, which, unlike glass, is readily permeable by the ultra-violet rays (Fig. 1). The sourc of light usually employed is that obtained by sparking one of the metals, such as iron, or a combination of metals, such as cadmium alloyed with lead and tin. In using the apparatus a photograp is first taken of the spectrum of the source of light A layer of the substance to be examined, which, if solid, must be dissolved in a suitable diactinic solvent such as alcohol or water, is then interposed betwee the source of light and the slit of the collimator, and

the absorption bands, but their degree of persistence i.e. the range of concentration within which they ar exhibited. It is necessary, therefore, to vary the con centration of the solution or the thickness of the laye so as to cover the whole phenomena of absorption This is done by simply diluting the solution, o diminishing the thickness of layer, on one hand, unti the entire spectrum is transmitted, and on the othe by increasing the concentration or the thickness of the layer until no further characteristic absorptive effect is produced. Photographs are taken at each concentration, and a curve is drawn connecting th concentration and the absorption as measured wit reference to the lines of the metal employed as a source of light (Fig. 3).

If we now inquire whether the substances which affect light in one or other of the different ways

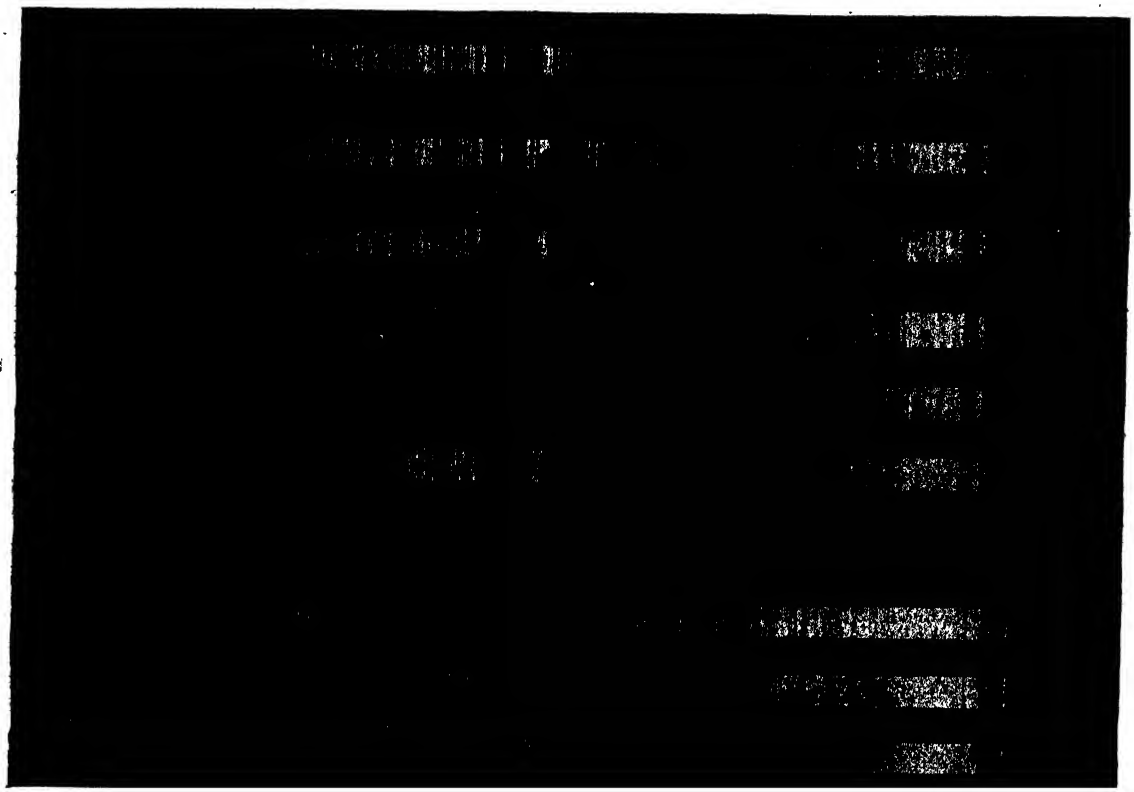

FIG. 2.—1. Spark spectrum of nickel and iron. 2 and 3. The same after the light has passed through water and solution of cane sugar respectively. Alcoholic solutions of (4) pinene, (5) thiophen, (6) citric acid illustrate general absorption, and alcoholic solutions of (7) isatin, (8) phenol (9) salicylic acid, (10) quinine hydrochloride illustrate selective absorption.

another photograph is taken. By comparison of the two photographs it is seen what effect, if any, the substance has had upon the transmission of the light.

When organic substances are examined in this way it is found that some allow light to pass freely through them. Others shorten the spectrum by absorbing the rays at the ultra-violet end to a greater or less extent, and are said to show general absorption. Others, again, possess the remarkable property of absorbing rays of a particular wave-length, thereby producing gaps or bands in the spectrum; these are said to show selective absorption (Fig. 2).

In studying these phenomena in their relation to the chemical characters of a substance, it is of importance to determine not only the extent of the general absorption and the number and position of

already indicated have themselves anything in common, we find that it is with those which possess the structure characteristic of benzene and its derivatives that the power of absorbing the rays of particular parts of the spectrum is most frequently, although not exclusively, associated.

Organic compounds, or compounds containing the element carbon, are divided into fatty or aliphatic, in which the carbon atoms are united in an open chain, and cyclic, in which the carbon atoms form a closed chain or ring. Hexane, which is a constituent of liquid paraffin, may be taken as an example of the first class. This substance possesses the formula C_6H_{14}. It is highly diactinic or transparent to the ultra-violet rays, and nearly all compounds belonging to the same division of organic chemistry, such as alcohols, sugars

and fatty acids, are either equally transparent to light, or only cut off a portion of the extreme ultra-violet rays of the spectrum.

If we now remove one atom of hydrogen from each of the two end carbon atoms of hexane, these atoms are in a condition to unite directly with each other, thus closing the chain. The substance so formed belongs to the cyclic division of organic compounds. It is known as cyclohexane, and has the formula C_6H_{12}, each carbon atom having two hydrogen atoms attached to it. This substance resembles hexane generally in its chemical properties, and behaves towards light in the same way, that is to say, it is practically diactinic or only cuts off some of the rays of light at the extreme ultra-violet end of the spectrum.

But a wholly different condition is brought about if we suppose one atom of hydrogen removed from each of the six carbon atoms of cyclohexane. One linkage is thus set free in each of the six carbon atoms, and we obtain benzene. How these linkages

FIG. 3.—1. Spark spectrum of nickel and iron. 2 to 12. The same after light has passed through layers of 0·001 normal solution of salicylic acid from 90 to 4 mm. thick.

are actually employed in benzene has never been determined with certainty. Sometimes they are represented as mutually neutralising one another, sometimes as effecting a double link between the alternate pairs of carbon atoms. However this may be, the structure which bears the relation that I have indicated to the structure of hexane and cyclohexane is characteristic of the large group of organic substances of which benzene is the type. It is to this division of the cyclic compounds that the great majority of substances which show selective absorption, *i.e.* produce breaks or dark bands in the spectrum, belong. Here, then, we have a very important and a very general relation between the structure of organic substances and their absorption spectra.

The difference in the behaviour of organic bodies towards the ultra-violet rays, as exemplified in hexane and cyclohexane, on one hand, and benzene on the other, is brought out very clearly when we examine some of their derivatives. If we replace an atom of hydrogen in hexane or cyclohexane by the monovalent group hydroxyl, we get substances belonging to the class of alcohols, and these substances are, like their parent substances, highly diactinic. If, on the other hand, we replace an atom of hydrogen in benzene by the same group we get carbolic acid or phenol, which, like benzene, exercises selective absorption on the ultra-violet rays, but gives a spectrum widely different from that of benzene.

Having dealt with the most general relation that has been observed between the structure of organic substances and their action on the ultra-violet rays, I propose to illustrate some of the more special relations by examples from the phenomena of isomerism. By replacing an atom of hydrogen in carbolic acid or phenol by the nitro-group we obtain three distinct nitrophenols. The ultimate particles or molecules of these nitrophenols are all composed of the same elements—carbon, hydrogen, oxygen, and nitrogen—and of the same number of atoms of each element. Such substances are said to be isomeric, *i.e.* they are made up of equal parts, although they do not possess the same properties. The difference between them lies in the arrangement of the parts relatively to each other; in this case in the position of the nitro-group in relation to the hydroxyl group. On comparing the spectra of the three nitrophenols we find that they differ in quite a marked manner from one another, and afford an illustration of the important general rule that substances which have the same composition but different spectra differ in structure.

It will have been noticed that the substitution of the nitro-group for hydrogen in phenol has the effect of shifting the absorption band nearer to the visible region. One of the three nitrophenols has a yellow colour, and in this case the gap in the spectrum cuts a little way into the violet end of the visible region. By the addition of soda to the solution the colour is changed to red, and on examining the spectrum of this solution we see that the gap now extends far into the visible region. This example will serve to illustrate the close connection that exists between the

study of absorption spectra and the origin of colour, an interesting branch of the subject with which, however, it is impossible for me to deal within the limits of this discourse.

In the nitrophenols we have an example of what is known as structural isomerism, or position isomerism, because the phenomenon depends upon differences in the position or arrangement of the atoms within the molecule—in other words, in the internal structure of the molecule. But it is possible to have two substances of the same composition and structure not identical, but related to one another as an object is to its mirror-image. Substances so related are termed optical-isomers or stereo-isomers. The spectra of isomers of this class, unlike those of structural isomers, do not differ. This leads to an important application of absorption spectra in chemical investigations. If two substances have the same composition but different spectra, we know that they must be structurally different; if, on the other hand, they have the same composition and the same spectra, and yet are not identical, there is a strong probability although not a certainty, that they are optical-isomers.

The study of absorption spectra has proved of special value in the investigation of substances capable of existing in two forms which may pass the one into the other. It is rarely the case that both forms of such substances are stable, and it is often extremely difficult, or altogether impossible, on account of this instability, to determine by the ordinary chemical processes which of the two possible forms the substance as we know it possesses. Such substances, however, frequently give rise to two series of stable isomeric methyl- or ethyl-derivatives, the structure of which can be ascertained by chemical investigation. The parent substance, if not a mixture of the two forms, must correspond in structure with one or other of these derivatives, because it is a well-established fact that the introduction of the methyl- or ethyl-group into a substance in place of an atom of hydrogen does not appreciably alter the spectrum.

An example of this is afforded by the three substances isatin, methyl-isatin, and methyl-pseudo-isatin. The structure of methyl-isatin and of methyl-pseudo-isatin has been determined by chemical methods, but the structure of the parent substance isatin cannot be determined in this way. Is it constituted like methyl-isatin or like methyl-pseudo-isatin? Inspection of the photographs of the spectra of the three substances shows that while there is a wide difference between the spectra of isatin and methyl-isatin, the spectra of isatin and methyl-pseudo-isatin are almost identical, as we should expect them to be on the view that they are constructed alike.

This phenomenon, which is known as tautomerism, is due to the fact that some substances contain an atom of hydrogen, or it may be a hydroxyl group, which readily shifts its position within the molecule, leaving its union with one atom to attach itself to another. Another example of this is afforded by cotarnine, a substance found in opium. The molecule of cotarnine possesses an atom of carbon which is directly combined with an atom of nitrogen, and has also united to it a hydroxyl group. Under the influence of certain reagents the hydroxyl group leaves the carbon atom and attaches itself to the nitrogen atom, but can readily, by an alteration of the conditions, be enticed back again to the carbon atom. The shifting of the position of the hydroxyl group is accompanied by other changes which, however, it is not necessary that we should take into account for our present purpose. In this case both the tautomeric forms are, under certain conditions, stable. The form in which the hydroxyl is attached to the carbon is colourless, while the form in which it is attached to the nitrogen is yellow. The two forms have totally distinct absorption spectra. When one of the forms passes into the other under the influence of the appropriate reagent, the amount of change is proportional to the quantity of reagent added. It is possible, therefore, by taking photographs after the addition of each successive quantity of reagent, to trace the progress of the change through all its phases, and to ascertain how much of each form is present at any time. This is done by comparison with a series of reference plates prepared by photographing mixtures

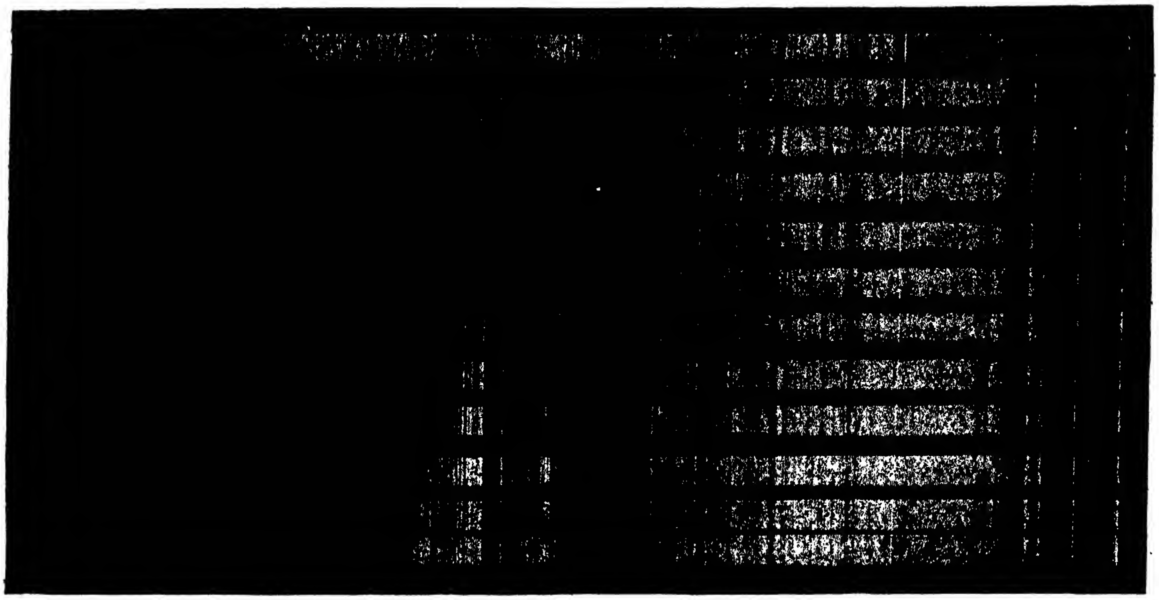

FIG. 4.—1. Spark spectrum of nickel and iron. 2 to 12. The same after the light has passed through layers from 60 to 4 mm. thick of an alcoholic solution of morphine containing $\frac{1}{200}$ grain of the alkaloid.

... various definite proportions of two derivatives of cotarnine which possess the same spectra as the two parent forms.

The study of the absorption spectra of the alkaloids has been applied with success, not only to the investigation of their structure but to their detection and estimation. These substances generally have very characteristic spectra by means of which they can be distinguished with certainty from one another, except when they are homologous or otherwise very closely related structurally. The spectroscopic method may, therefore, be used with great advantage in examinations for the presence of alkaloids to confirm the results obtained by the usual chemical tests. The chemical tests are no doubt as a rule sufficiently distinctive, but considering the gravity of the circumstances in which they have frequently to be applied, it is unnecessary to insist on the value of the confirmatory evidence which can be obtained by the use of the spectroscope.

The minutest quantities of alkaloids can be detected by this means, the method rivalling the colour reactions for the alkaloids in delicacy. Thus, with a quantity of strychnine not exceeding 1/500 of a grain, a clearly defined spectrum of the alkaloid can be obtained. The photograph of morphine already shown was obtained with 1/200 of a grain of the alkaloid, and that of nicotine with 1/100 (Fig. 4).

The use of the spectroscope in the detection and estimation of alkaloids in cases of poisoning possesses certain advantages of the highest importance. One is that the material is not destroyed. The solution which has been employed for the spectroscopic examination can be used afterwards for the chemical examination. Another is that a permanent record is obtained which is always available for reference.

So far my illustrations have been confined almost entirely to colourless substances, because it is in connection with the investigation of such substances that most of the recent advances in the subject have been made.

As my last example, I shall take the case of a coloured substance in which the method has been applied within the last year with marked success.

It will be remembered that considerable uneasiness was caused when it became known some time ago that nitrogen peroxide is sometimes employed to bleach flour. In the course of an inquiry into the subject, it became necessary to determine the nature of the colouring matter naturally present in flour. It was known that many of the yellow and orange pigments so widely distributed throughout the vegetable kingdom are either closely connected or identical with carrotene, the orange colouring matter of carrots, and it had been suggested that the colouring matter of unbleached flour might be identical with, or belong to the same class of colouring matters as, this substance. It was impossible, however, to prove this by the usual chemical methods, because the amount of colouring matter in flour is so minute that its isolation in a pure state, and in sufficient quantity for chemical analysis, was scarcely practicable. Carrotene, however, can be prepared in a pure state, and the happy idea occurred to Dr. Monier Williams, of the Local Government Board, who was conducting the investigation, to photograph its absorption spectrum and compare it with that of the colouring matter of flour, which could easily be obtained in the minute quantity required for this purpose. Inspection of the photographs shows that the spectra are very similar. There cannot, therefore, be any doubt that the colouring matter of flour, if not identical with, is closely allied to, carrotene.

The underlying causes of the relations between chemical structure and absorption spectra have been the subject of much speculation, but it must be confessed that no satisfactory explanation of the phenomena of absorption has yet been formulated, and that the theoretical development of the subject lags behind its practical application.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

On the occasion of the installation of the Duke of Northumberland as Chancellor of Durham University on May 3, honorary degrees of the University were conferred on the following men of science:—*D.C.L.*, Lord Rayleigh; *D.Sc.*, Sir Archibald Geikie, K.C.B., P.R.S., Sir William Ramsay, K.C.B., Sir T. C. Allbutt, K.C.B., Sir J. A. Ewing, K.C.B., Sir William Crookes, O.M.; Sir J. J. Thomson, O.M., and Prof. E. B. Poulton.

In the House of Commons on Monday, May 5, Mr. Asquith, replying to several questions referring to the recent decision of the Convocation of the University of Oxford as to Divinity degrees, said:—"I have for a long time had under consideration the various proposals for the appointment of a Royal Commission or Commissions to inquire into the constitution of, and other matters connected with, the Universities of Oxford and Cambridge. I have reluctantly come to the conclusion that in existing circumstances the setting up of such an inquiry might lead to delay in the prosecution of necessary reforms and is not likely to be productive of fruitful consequences."

The first session of the new University of Western Australia was inaugurated on Monday, March 31, with an address on the place of mathematics and physics in a university education, by Prof. A. D. Ross. About 150 students have enrolled in the faculties of arts, science, engineering, and agriculture. At present the teaching is being carried on under considerable difficulties, as the portion of the temporary buildings which has already been erected does not afford accommodation for laboratory instruction. The work of extending the premises is, however, being pushed on rapidly, and the various science departments should be in a position to carry on their practical work in the third term.

The April number of *The Eugenics Review* is mainly occupied with the report of the Eugenics Education Conference, which took place on March 1, and was reported in Nature of March 6. As a practical outcome of the conference a deputation, having for its object the introduction of teaching of eugenics in training colleges, waited on Mr. Trevelyan, M.P., at the offices of the Board of Education on April 2. The deputation, which included, among others, the president of the Eugenics Education Society, the Dean of St. Paul's, the headmaster of Eton, the principal of Bedford College, and Mr. Nicholls, ex-president of the National Union of Teachers, was sympathetically received by Mr. Trevelyan, who said that the Board of Education recognised the importance of the matter referred to, and would consider carefully the recommendations made by the deputation. From the "Notes" column of the review we learn of the formation on January 29 of the Société Française d'Eugénique. The president of this society is M. Edmond Perrier, the general secretary M. le Dr. Apert, and the treasurer and librarian M. Lucien March. In Italy a eugenics society is in course of formation, and in Denmark, at the instigation of Dr. Soren Hansen, a eugenics section of the Anthropological Committee has been organised. The research committee of the Eugenics Education Society

issues an appeal for help (not financial) in a cooperative research recently set on foot, particulars of which may be obtained on application to the chairman of the research committee, Eugenics Education Society, Kingsway House, Kingsway, London, W.C.

AT the annual meeting of the National Education Association, held on May 2, Lord Sheffield made some interesting comparisons between the educational systems of Scotland and England. Supplementary courses are recognised for all schools in Scotland, where, at the end of August, 1911, there were 2056 such courses in 3173 primary schools, and they had 49,497 pupils above twelve years of age in average attendance, out of a total of 783,792 pupils in average attendance. The grants to pupils in these courses amount to more than 4*l.* a head, while in England the grant is 2*l.* a head to pupils in elementary schools. In Scotland 6·3 per cent. of the pupils are under advanced instruction in ordinary schools, or about 30 per cent. of the pupils above twelve years of age in ordinary elementary schools. In England there are no such pupils and no such classes, but there were, in 1911–12, 1,032,000 pupils above twelve years. There are 194 higher grade schools in Scotland, with more than 24,000 pupils in average attendance, or 3·2 per cent. of all the pupils in elementary schools. In 1910–11 there were only forty-seven such schools in England and Wales, with 8852 pupils, or less than one-twentieth of the Scotch proportion. The grants for these schools in Scotland are 2*l.* 10*s.* a head for the first year, 3*l.* 10*s.* for the second year, 4*l.* 10*s.* for the third and further years, all capable of an increase of 10 per cent. for good work. The grants of the English code for higher elementary schools are: first year, 30*s.*, second, 45*s.*, third, 60*s.*, or an average just above 2*l.* a head, and, with the fee grant and aid grant, a total of 3*l.* a head. The assimilation of the English higher elementary schools to the Scotch higher grade schools in all matters could be done by departmental action alone. The Scotch report for 1912–13 shows that more than 95 per cent. of the teachers are certificated, and 68 per cent. trained, and there is one certificated teacher to thirty-nine pupils. In England and Wales there is one certificated teacher to about fifty-two pupils, and in 1911–12 less than 65 per cent. were certificated. The average salaries of teachers certificated are, in Scotland in 1910–11, men, 138*l.*, women, 83*l.*; in England, men, 127*l.*, women, 92*l.* In Scotland the salaries work out at about 3*l.* per pupil, and in England and Wales at about 2*l.* 17*s.* 4*d.* per pupil. The total cost of board schools in Scotland for school maintenance and interest and repayment of loans is about 4*l.* 16*s.* In England it is between 4*l.* 8*s.* and 4*l.* 10*s.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 1.—Sir Archibald Geikie, K.C.B., president in the chair.—Prof. E. H. **Griffiths** and Ezer **Griffiths**: The capacity for heat of metals at different temperatures. The thermal capacity, at various temperatures between 0° and 100°, of the following metals has been determined:—Cu, Al, Fe, Zn, Ag, Cd, Sn, and Pb. The work at lower temperatures will be published later. The variation in the thermal capacity can be represented (over the range 0° to 100°) by the following parabolic equations, the difference between the calculated and experimental values in no case exceeding 0·2 per cent. In the large majority of cases the difference is less than 0·1 per cent.

Cu	$s=0{\cdot}09088\ (1+0{\cdot}0005341t-0{\cdot}00000048t^2)$,
Al	$s=0{\cdot}20957\ (1+0{\cdot}0009161t-0{\cdot}00000017t^2)$,
Fe (ingot)	$s=0{\cdot}10452\ (1+0{\cdot}001520t-0{\cdot}00000617t^2)$,
Zn	$s=0{\cdot}09176\ (1+0{\cdot}00005605t-0{\cdot}00000178t^2)$,
Ag	$s=0{\cdot}05560\ (1+0{\cdot}0003396t-0{\cdot}000000141t^2)$,
Cd	$s=0{\cdot}05475\ (1+0{\cdot}000520t-0{\cdot}000000725t^2)$,
Sn	$s=0{\cdot}05363\ (1+0{\cdot}0006704t-0{\cdot}000000458t^2)$,
Pb	$s=0{\cdot}030196(1+0{\cdot}000400t-0{\cdot}00000036t^2)$,

Many forms of equations were tried, but it was found that the experimental results were more closely represented by the parabolie than by any other form.—A. **Robertson** and G. **Cook**: The transition from the elastic to the plastic state in mild steel. The paper deals with the reduction of stress at the yield point in mild steel. Apparatus for limiting the extension during yield to a value comparable with the elastic extension, and for securing axial loading, are described. Under these conditions twelve specimens were tested, and a reduction of stress of 24 to 36 per cent. observed in eleven, and of 17 per cent. in the other one.—F. P. **Worley**: Studies of the processes operative in solutions. XXVIII., The influence of acids on the rotatory power of cane-sugar, of glucose, and of fructose. Experiments on the hydrolysis of cane-sugar by solutions of benzene-sulphonic acid have confirmed the conclusion previously arrived at from those in which sulphuric acid was used, that the ratio of the negative optical rotation at the completion of hydrolysis to the initial positive rotation increases rapidly as the concentration of the acid is increased. The increase is proportional to the concentration of the acid, and in the case of benzenesulphonic acid amounts to about 20 per cent. when the concentration is increased from zero to twice normal. It has been found that the increase is due entirely to the influence of the acid on the rotatory power of the three sugars, cane-sugar and glucose being made somewhat less dextro-rotatory and lævulose considerably more lævo-rotatory by the presence of the acid.—H. G. J. **Moseley**: The attainment of high potentials by the use of radium. A radio-active substance which emits β-radiation should, when insulated, continue to gain a positive charge until a potential of the order of a million volts is reached. Experiments have been made to test this point. A small bulb containing radium emanation was supported by a quartz rod at the centre of a highly exhausted flask. A disc suspended from a quartz spring in the neck of the flask formed a simple attracted disc electrometer. It was found that a bulb of 9 mm. diameter reached a potential of 160,000 volts in the course of a few minutes. A sudden discharge then occurred through the residual gas in the flask. A bulb of 5 cm. diameter charged up much more slowly: no discharge took place, and the final potential, 110,000 volts, was limited by a leak of electricity along the quartz support.—E. **Marsden** and Dr. T. S. **Taylor**: The decrease in velocity of α particles in passing through matter. The relative velocities of the α particles of radium C before and after passing through foils of various thicknesses have been investigated by means of the deflection caused by a magnetic field. Tables are given showing the results for gold, copper, aluminium, mica, and air.

Linnean Society, April 17. Prof. E. B. Poulton, F.R.S., president, in the chair.—M. P. **Price** and N. D. **Simpson**: Plants collected on the Carruthers-Miller-Price expedition through north-west Mongolia and Chinese Dzungaria.—E. G. **Baker**: Some British varieties of the bee-orchis, *Ophrys apifera*, Huds. In the typical form of the bee-orchis the labellum is broad convex, with a terminal, reflexed appendage, brown-purple, disc spotted with orange-yellow. In 1840 Hegetschweiler, in "Die Flora der Schweiz,"

described and figured *Ophrys Trollii*, a plant with the middle lobe of the labellum narrow lanceolate, elongated, purplish-red in the centre, gold at the edge, the three outer perianth-lobes lanceolate pointed. The plant came from Winterthur. In this country there appears to be a series of intermediate forms connecting the typical form with *O. Trollii*, some being more nearly allied to the former, some to the latter.—Dr. Hisayoshi **Takeda**: The flora of Shikotan. Shikotan is the southernmost of the Kurile Islands, which are distributed in the form of a chain between Kamtschatka and Yezo, and lies between about 43° 35′ and 50′ N. and 146° 30′ and 55′ E. Its area does not perhaps exceed 140 sq. m. The island is hilly, and some of the hills are covered with forests of conifers and deciduous trees, others with dwarf bamboos—species of Sasa. There are many streams along which bogs and swamps are often well developed. The vegetation of this island has scarcely been touched by human hands, but left in quite a primitive state. The number of the higher plants known to the author is 324, belonging to 213 genera and sixty-two families, of which 245, including eight new species, are new to the flora of this island, while 136 species are not mentioned in Miyabe's "Flora of the Kurile Islands," published in 1890, and also fifty-eight genera and eight families are additions to that publication. Among plants which are common to Shikotan (and also other islands of the Kuriles) and Yezo, or Yezo and Hondo, but not found in Saghalien, there are a number of plants which are distributed over north-eastern Asia, the Aleutian Islands, &c. These plants are believed by the author to have been introduced through the Kurile chain, but not through Saghalien.

Zoological Society, April 22.—Mr. E. T. Newton, F.R.S., in the chair.—Dr. S. F. **Harmer**: The polyzoa of waterworks. An account was given of the serious trouble which had been caused by the occurrence of a rich and varied fauna in the pipes of certain foreign waterworks, notably at Hamburg and Rotterdam. As was first shown by Kraepelin, the polyzoa play a prominent part in the activity of the pipe-fauna, by feeding on diatoms and other microscopic organisms, and serving in their turn as the food of other animals which prey on one another. The nutritive matter rendered available by the presence of enormous numbers of polyzoa is thus in large measure responsible for the existence of other constituents of the fauna, which may include even fishes, such as the eel and the stickleback. The organic material supplied by the disintegration of the polyzoa and other animals is believed to be important for the nutrition of iron-bacteria, which are well known to cause the most serious trouble in waterworks. An account was given of five cases of the occurrence of polyzoa in English waterworks in sufficient numbers to give rise to very serious inconvenience. In one or two of these cases the advice given by Kraepelin, in his paper on the Hamburg pipe-fauna, was being followed, by the introduction of a system of filtration, the principal object of which is to remove the microscopic organisms on which the polyzoa, and ultimately the whole assemblage of animals in the pipes, depend for their nutriment.—A. W. **Waters**: The marine fauna of British East Africa and Zanzibar, from collections made by Cyril Crossland, in the years 1901–2. Bryozoa—Cheilostomata. In the collection dealt with from the neighbourhood of Zanzibar there are seventy-six species or varieties of cheilostomatous bryozoa, almost all being from ten fathoms or under, so that for a shallow-water collection it is very large.—Major J. **Stevenson-Hamilton**: Occurrence of albino examples of the reed-buck (*Cervicapra arundinum*) in the Sabi Reserve, Transvaal. Some interesting notes were also given on the habits and distribution of Sharpe's steenbuck (*Raphiceros sharpei*), which resembles the grysbok much more closely than it resembles the common steenbuck in mode of life, and ranges from Nyasaland to the Transvaal, but gradually dies out to the south-east of that country.

Geological Society, April 23.—Dr. Aubrey Strahan, president, in the chair.—R. H. **Goode**: The fossil flora of the Pembrokeshire portion of the South Wales Coalfield. Of the fifty-three determinable species of fossil plants obtained from the Pembrokeshire portion of the South Wales Coalfield, three are new species. From the palæobotanical evidence it is clear that the so-called "Pennant Grit" of Pembrokeshire cannot be regarded as the equivalent of the Pennant Grit of the main portion of the South Wales Coalfield. Until more plants have been obtained from the so-called "Millstone Grit" of Pembrokeshire, it is impossible to fix definitely the horizon of these beds. However, it is evident that the beds assigned to the Millstone Grit probably belong to the Middle Coal Measures. Thirty-two fossil plants have been obtained from the Middle Coal Measures of Pembrokeshire which have not as yet been recorded from those of the main South Wales Coalfield.—H. **Kay**: The Halesowen Sandstone Series of the southern end of the South Staffordshire Coalfield, and the petrified logs of wood found therein at Witley Colliery, Halesowen (Worcestershire). With an appendix on the structure of a new species of Dadoxylon, by E. A. Newell **Arber**. The Halesowen coal-seam and associated beds of blue clay form a definite intermediate horizon traceable across the coalfield. The area is folded into two anticlines with a deep central syncline ranging south-south-eastwards, and the strata have a south-south-easterly dip. The northern face is let down by a fault repeating the lower beds. Other faults throw southwards, and yet others intersect the anticlines. Mining operations show the existence of a buried anticline with the full Coal-Measure Series. The Witley Colliery railway-cutting shows big logs of petrified wood finely preserved by calcite, and of Upper Carboniferous age. The wood has been examined by Dr. Newell Arber, who finds it to have Araucarian affinities, but of a species new to science. In consequence of its Palæozoic age, it is referred to the genus Dadoxylon. The type of preservation is also new to this horizon in this country, and the discovery of Dadoxylon at Witley constitutes a new record for British Upper Carboniferous rocks.

Manchester.

Literary and Philosophical Society, March 18.—Prof. F. E. Weiss, president, in the chair.—W. H. **Sutcliffe**: A criticism of some modern tendencies in prehistoric anthropology. During the last few years there has been a great revival of interest in the study of Palæolithic man and his instruments in Britain, some of which are of great importance on account of the care and skill with which they have been worked, whilst others appear to be founded on untrustworthy evidence. The author discussed such of these latter as lead to the necessity of demanding a pre-Pleistocene arrival of man in Britain. The Kent plateau eoliths were examined and compared with the chipped flints found by Mr. V. Commont and l'Abbé H. Breuil in the Thanetian beds of north France and those described by Mr. Hazzledine Warren from the undisturbed "clay with flints." It was pointed out that, from our extensive knowledge of the fauna of this formation (Rheims and New Mexico), it is quite certain that no tool-using animal could possibly have

been present at this remote time, and that therefore these flints, some of which closely resemble well-made implements, must be of purely natural origin. The "rostro-carinate" flints described by Sir E. Ray Lankester from the Red Crag were next examined, and it was shown that the same type occurs in the ordinary Palæolithic gravel of Hackney Downs. Lankester has also found the same type in the Middle Miocene of Aurillac. It is inconceivable that a human production should have retained exactly the same form throughout this immense period considering the rapidity of evolution of type shown among Palæolithic implements. The "rostro-carinate" flints were found to be not adapted to any likely use, and the conclusion is reached that they cannot be held to give good evidence of the existence of Pliocene man. On examining the age of the Galley Hill and Ipswich skeletons, the extreme improbability of the only two known human remains found in gravel (prior to the recent discovery of the Sussex man) each being a complete skeleton, in view of the very great rarity of even small associated sets of bones of other mammals in the same and similar gravels, was dwelt upon. The Galley Hill skeleton's authenticity depends on the evidence of two witnesses with no geological training, who contradict one another on so fundamental a fact as the nature of the bed in which it lay—one called it mould, the other gravel. As regards the Ipswich man, the author pointed out the impossibility of a human skeleton lying closely contracted on a surface of loose sand resisting the action of a glacier which is supposed to have deposited Boulder Clay over it. The conclusion was reached that both skeletons are merely burials of quite comparatively recent date.

April 8.—Prof. F. E. Weiss, president, in the chair.—W. **Burton**: Note on black pottery from Ashanti and the Gold Coast.—W. **Thomson**: The influence of moisture in the air on metabolism in the body. The author had previously pointed out that metabolism in the lungs (as indicated by the percentage of carbonic acid gas in the exhaled air) took place to a greater extent when breathing dry than when breathing damp air. He now tested this further on the effect of the various alterations in the atmosphere, viz. the combined influence of pressure, temperature, and hygroscopic state of the atmosphere on the carbonic acid gas contained in the exhaled air from the lungs. His experiments showed that some people are more sensitive than others to dry or damp air, but the general result showed that the difference of the carbonic acid gas in the exhaled air, when breathing cold damp air, amounted to about 4 per cent. increase when breathing cold dry air, whilst with warm air the difference showed an increase for the warm dry air of 7·53 per cent.

April 22.—Prof. F. E. Weiss, president, in the chair.—Prof. F. E. **Weiss**: A Tylodendron-like fossil. While agreeing in general external appearance and also to some extent in the structure of the remains of the woody tissues found outside the pith, the latter was remarkable for the considerable development of secretory canals in its thin-walled tissue. The presence of these and other considerations led the author to the conclusion that the pith was more likely to have belonged to a plant of Cycadian than to one of Araucarian affinity.—W. **Robinson**: Some relations between *Puccinia malvacearum*, Mont., and the tissues of its host. The general features of the pustules as shown on petiole, stem, and leaves of the hollyhock (*Althaea rosea*) were described. The relations of the distribution of the fungal mycelium to the starch content of the host were pointed out, and the relations between the haustoria and the individual cells were dealt with. By a series of plasmolysis experiments the haustoria were demonstrated to enter cells which remained living after entry, and they were shown to lie within the protoplasm and to grow towards the nucleus. The results indicate a slow tapping of the resources of living cells by the haustoria, which are able to penetrate the protoplasm in such a way that the cells remain alive for a considerable time.

BOOKS RECEIVED.

Bergens Museum. Aarsberetning for 1912. Pp. 119. (Bergen: J. Griegs Boktrykkeri.)

Uebungsbeispiele aus der unorganischen Experimentalchemie. By H. and W. Biltz. Zweite Auflage. Pp. xi+237. (Leipzig: W. Engelmann.) 8 marks.

Ministry of Finance, Egypt. Survey Department. Report on the Work of the Survey Department in 1911. Pp. 76. (Cairo: Government Press.) 10 P.T.

General Index to *The Chemical News*. Vols. i. to c. Pp. iii+712. (London: *Chemical News* Office.) 2*l*.

The People's Books:—The Science of Light. By Dr. P. Phillips. Pp. 92. Gardening. By A. C. Bartlett. Pp. 94. British Birds. By F. B. Kirkman. Pp. iv+96. (London and Edinburgh: T. C. and E. C. Jack.) 6*d*. each.

Malaria, Cause and Control. By Prof. W. B. Herms. Pp. xi+163. (London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

Problems in Eugenics. Vol. ii. Report of Proceedings in the First International Eugenics Congress, held at the University of London, July 24 to 30, 1912, together with an Appendix containing those Papers communicated to the Congress not included in vol. i. Pp. 189+index. (London: Eugenics Education Society.)

La Matière. Sa Vie et ses Transformations. By Prof. L. Houllevigue. Pp. xxxii+319. (Paris: A. Colin.) 3.50 francs.

Fortschritte der Mineralogie, Kristallographie, und Petrographie. Edited by Dr. G. Linck. Dritter Band. Pp. 320. (Jena: G. Fischer.) 10 marks.

Manual of Wireless Telegraphy and Telephony. By A. F. Collins. Third edition. Pp. xv+300. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 6*s*. 6*d*. net.

The Theory and Practice of Working Plans (Forest Organisation). By Prof. A. B. Recknagel. Pp. xii+235+vi plates. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

Schnee und Eis der Erde. By Prof. H. Wieleitner. Pp. 198+xvi plates. (Leipzig: P. Reclamm, jun.) 1 mark.

Bogen und Pfeil bei den Volkern des Altertums. By E. Bulanda. Pp. vi+136. (Vienna and Leipzig: A. Hölder.) 6.80 marks.

Gouvernement Egyptien. Administration des Arpentages. Catalogue des Invertébrés Fossiles de l'Egypte représentés dans les Collections du Geological Museum au Caire. By R. Fourtau. Pp. 93+vi plates. (Le Caire: Imprimerie Nationale.) 40 P.T.

Religious Beliefs of Scientists. By A. H. Tabrum. New edition. Pp. xxi+309. (London: Hunter and Longhurst.) 2*s*. 6*d*. net.

A Synopsis of the Classification of Insects. By Prof. H. M. Lefroy. Pp. 32. (London: Lamley and Co.) 1*s*. net.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Lief. 32–33. (Jena: G. Fischer.) 5 marks each Lief.

Vorlesungen über allgemeine Histologie. By Prof. A. Gurwitsch. Pp. v+345. (Jena: G. Fischer.) 11 marks.

Photographic Supplement to Stanford's Geological Atlas of Great Britain and Ireland. Arranged and edited by H. B. Woodward, with the cooperation of Miss H. D. Sharpe. Pp. 113. (London: E. Stanford, Ltd.) 4*s.* net.

Die europaeischen Schlangen. By Dr. F. Steinheil. Erstes Heft. 5 plates. (Jena: G. Fischer.) 3 marks.

Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. vi., A Study of Maya Art: its Subject Matter and Historical Development. By H. J. Spinden. Pp. xxiii+285+29 plates+map. (Cambridge, Mass.: Peabody Museum.)

Monographs of the United States Geological Survey. Vol. li., Cambrian Brachiopoda. By C. D. Walcott. Part i. Text. Pp. 872. Part ii. Plates. Pp. 363+civ plates. (Washington: Government Printing Office.)

Thirty-third Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior. For the Fiscal Year ended June 30, 1912. Pp. 175. (Washington: Government Printing Office.)

United States Geological Survey. Professional Paper 77. Geology and Ore Deposits of the Park City District, Utah. By J. M. Boutwell, with contributions by L. H. Woolsey. Pp. 231+xliv plates. (Washington: Government Printing Office.)

United States Bureau of Entomology. Bulletin No. 91. The Importation into the United States of the Parasites of the Gipsy Moth and the Brown-tail Moth. By L. O. Howard and W. F. Fiske. Pp. 344+xxviii plates. (Washington: Government Printing Office.)

Researches into Induced Cell-Reproduction and Cancer, and other Papers. Vol. iii. By H. C. Ross, J. W. Cropper, E. H. Ross, H. Bayon, W. J. A. Butterfield, E. Jennings, and S. R. Mowlgavkar. (The John Howard McFadden Researches.) Pp. 149. (London: John Murray.) 5*s.* net.

Physikalische Chemie der homogenen und heterogenen Gasreaktionen. By Dr. K. Jellinek. Pp. xiv+844. (Leipzig: S. Hirzel.) 30 marks.

Annual Report of the Board of Scientific Advice for India for the Year 1911–12. Pp. 201. (Calcutta: Superintendent Government Printing, India.) 1*s.* 6*d.*

A Dictionary of English and Folklore-Names of British Birds. By H. K. Swann. Pp. xii+266. (London: Witherby and Co.) 10*s.* net.

DIARY OF SOCIETIES.

THURSDAY, MAY 8.

ROYAL SOCIETY, at 4.30.—The Various Inclinations of the Electrical Axis of the Human Heart: A. D. Waller.—Trypanosome Diseases of Domestic Animals in Nyasaland. III.: *Trypanosoma pecorum*: Surg.-Gen Sir D. Bruce, Major D. Harvey, Major A. E. Hamerton, and Lady Bruce.—The Excystation of *Colpoda cucullis* from its Resting Cysts and the Nature and Properties of the Cyst Membranes: T. Goodey.—The Experimental Hybridisation of Echinoids: C. Shearer, W. de Morgan, and H. M. Fuchs.

CONCRETE INSTITUTE, at 7.30.—Shear and Problems arising therefrom: H. K. Dyson.

FRIDAY, MAY 9.

ROYAL INSTITUTION, at 9.—Life History of a Water Beetle: F. B. Browne.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Polar Diameter of Saturn and tion of the Sun's Influence in Magnetic Storms: Rev. A. L. Cortie.—The Motions and Distances of the Pleiades and other Groups of Stars: H. C. Plummer.—*Probable Papers*: A Regular Law representing Wolf's Sun-spot Numbers: H. H. Turner.—Preliminary Discussion of the Discordance between the Observed and Predicted Positions of Jupiter's Eighth Satellite: J. Jackson.—Photographic Determination of the Proper Motions of 250 Stars in the Neighbourhood of Σ443: A. A. Rambaut.

SATURDAY, MAY 10.

ROYAL INSTITUTION, at 3.—Humphrey Internal Combustion Pumps: H. A. Humphrey.

TUESDAY, MAY 13.

ROYAL INSTITUTION, at 3.—Recent Physiological Inquiries; (3) Ductless Glands and their Dominating Influence: Prof. W. Stirling.

FRIDAY, MAY 16.

ROYAL INSTITUTION, at 9.—The Pygmies of New Guinea: Captain C. G. Rawling.

PHYSICAL SOCIETY, at 8.—Some Experiments to Detect β-rays from Radium A.: Dr. W. Makower and Dr. S. Russ.—Dust Figures: Dr. J. Robinson.

SATURDAY, MAY 17.

ROYAL INSTITUTION, at 3.—Humphrey Internal Combustion Pumps: H. A. Humphrey.

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A NEW TEXT-BOOK OF PHYSIOLOGY.

Principles of Human Physiology. By Prof. E. H. Starling, F.R.S. Pp. xii+1423. (London: J. and A. Churchill, 1912.) Price 21*s.* net.

TO one familiar with modern text-books of human physiology, the title of this work suggests something out of the common run. Excellent "elements" of the subject, "manuals," and "text-books" exist in plenty. Indeed, English-speaking students are exceptionally fortunate in possessing as they do such a selection of trustworthy and often attractive presentations of the established facts of the science. At the same time many teachers have undoubtedly felt that the existing students' text-book, admirable as it is, is not in all things in tune with the times, and that a new presentation in which more attention should be paid to recently revealed or recently applied "principles" would be a welcome acquisition. Prof. Starling's work is a response to this commonly-felt *desiderium.*

To attempt to combine an up-to-date exposition of the traditional subject-matter of a manual of human physiology with a sufficiently well-informed *résumé* of new and unfamiliar but appropriate branches of chemistry and physics, showing wherever available the connection between the one and the other, and in addition indicating the general trend of modern physiological investigation, implies qualifications rarely met with in one individual. It will be generally conceded that no one, whether from versatility of personal experience or from environment, was more competent than Prof. Starling to undertake the task. It will be equally conceded that his reputation has not suffered in the achievement. In more respects than one the book represents an advance on previous works of a similar kind.

A word as to its history. Some fifteen or twenty years ago there existed an unpretentious little volume by the author entitled "Elements of Human Physiology." Admirably concise, clear in thought and style, no better epitome of physiology could be put in the hands of a student. The author subsequently enlarged this book, leaving the title unchanged. Although the enlargement went through a number of editions, it was never such an unqualified success as the original, at least from the reader's point of view. Like the new dress of the little girl who had made up her mind to cry, it was "either too long or too short." The present volume represents a further transformation, in which the whole work has been recast and greatly expanded, and the title changed. At the same time it carries within it unmistakable and almost ineffaceable traces of its predecessors.

An important feature of the book is the insertion of an introductory section on general physiology. This consists for the most part of two substantial chapters, one on the chemistry of cells and food materials, the other on elementary physical chemistry so far as it bears on physiology. The latter is a welcome innovation, for it provides essential information that can otherwise be obtained only with difficulty. The bulk of the volume is devoted to the stock subject-matter of a text-book of physiology, the material being grouped under two main headings, "The Mechanisms of Movement and Sensation" and "The Mechanisms of Nutrition." The author's first-hand experimental knowledge is especially brought out in the latter of these, while the former is mainly notable for the incorporation of Sherrington's work on the central nervous system. The book ends with a short section on reproduction. Apparently the author has not considered the time ripe for the introduction of a special section on growth. The book is illustrated with a wealth of pictorial matter, chiefly in the form of diagrams.

While the work as a whole bears evidence of strenuous effort to bring it up to date (it contains a large amount of material comprised in no other general text-book of physiology), the process of modernisation is unequal. Thus, the value of the chapters on muscle and nerve has been enhanced by the inclusion of much recent investigation, especially of workers in the Cambridge school, but the partial selection of this material and the omission of other recent Continental work indicate that the author has failed to grasp some of the most suggestive teachings of nerve and muscle experiment. Again, the chapter on coagulation of the blood contains an admirable history of the coagulation question almost up to the date of publication, but the account of blood-platelets, with which coagulation is so intimately associated, is not only inadequate, but in regard to many statements quite misleading.

The omission of any single section on the liver is difficult to explain. While a considerable amount of information (not always correctly indexed) on the physiology of the organ is scattered throughout the book, the structure and vascular relations of the liver are not described.

One greatly regrets that the author has not seen his way to provide occasional references to original papers. A good scientific text-book has two classes of readers, students and research workers. To the latter a handy reference is most acceptable. For students the systematic mention of names and *dates* (the latter word might be

M

written in capital letters), is an indispensable part of the apparatus of scientific education. On glancing over those names that are incorporated in the body of the text or attached to important illustrations, one cannot but remark how very English the experimental side of physiology has become.

Breadth of outlook, to which the author lays some claim in his preface, has been secured not in every case by new and suggestive presentation of the materials to hand. Often enough, the author has depended rather on weight of added fact to illumine the intelligence of his readers. The consequence is that while he possesses a clear style that states scientific fact and argument without prolixity or ambiguity, his book makes at the best hard reading, its perusal being calculated to inspire respect rather than enthusiasm for the subject. Its obvious merits, however, outweigh all its defects.

Textual errors and other discrepancies are present in not too great abundance. While no serious blunder of this kind has caught the eye of the reviewer, he *would* venture to protest against the retention of the Egyptian-like perspective of fig. 60.

BRITISH BOTANISTS.

Makers of British Botany: a Collection of Biographies by Living Botanists. Edited by F. W. Oliver. Pp. iv + 332 + xxvi plates. (Cambridge University Press, 1913.) Price 9s. net.

THE decision to publish the course of lectures on British botanists given at London University in 1911 was a very wise one, and Prof. F. W. Oliver deserves our sincere thanks for the trouble he has taken to produce so excellent a result. The volume is full of interest, and contains much concerning the lives and activities of some of the lesser-known British botanists that might otherwise have passed into oblivion.

Modern botanists, after the perusal of the several biographies, may well reflect not only when they consider the remarkable energy of their distinguished predecessors, but also when they realise, as they now can, how great were the advances made in botanical science, despite innumerable difficulties, by the pioneers of the subject.

The ten lectures of the course deal with the work of the following botanists: (1) Morrison (1620–83) and Ray (1627–1705); (2) Grew (1641–1712); (3) Hales (1677–1761); (4) Brown (1773–1858); (5) Sir W. Hooker (1785–1865); (6) Henslow (1796–1861); (7) W. Griffith (1810–45); (8) Henfrey (1819–59); (9) Harvey (1811–66); and (10) Williamson (1816–95).

Since these biographies did not, of course, include all the distinguished botanists to whose labours we owe the foundation of botanical science in this country, it was wisely decided to supplement the lectures by the inclusion of chapters dealing with certain other botanists equally deserving of recognition as founders of the science. Even with the inclusion of these worthies, namely, Hill (1716–75), Lindley (1799–1865), Berkeley (1803–89), Gilbert (1817–1901), Marshall Ward (1854–1905), the Edinburgh professors (1670–1887), and especially J. H. Balfour and Sir Joseph Hooker (1817–1911), the list is incomplete. Bentham, for instance, is an unfortunate omission, and it is to be hoped that it may not be long before a second edition is called for and that Prof. Oliver may carry out his intention of adding accounts of several other British botanists who should never be excluded from a historical account of botany in Britain.

Where the general level is so high, it is perhaps invidious to single out individual essays for special commendation, but of the lectures, Hales by Sir Francis Darwin and the account of Robert Brown by Prof. Farmer are of particular interest. The value of the volume is also very much enhanced by Sir W. T. Thiselton-Dyer's masterly account of Marshall Ward and by Prof. Bower's life of Sir Joseph Hooker, a task from its magnitude perhaps harder than that which fell to any other contributor to the volume.

One of the chief reasons why we are grateful for this book is not so much that it tells us once more about men whose names are as household words, but rather because the value of the work done by those whose contributions to the science have been known only to the few can now be seen in its true light by all. Until the appearance of the book, how few of the younger botanists could have given a coherent account of the work of William Griffith, Henfrey, or Harvey?

Griffith, as Prof. Lang points out, was a great botanist

> It is true that he failed to break through the limitations of his time and period, that he left no new and more correct general views to modify the science. But this is true of all his contemporaries; indeed, it is true of most botanists. To recreate the department of a science in which a man labours requires a combination of ability and fortunate chances that is given to few."

It is especially fitting to remember Griffith at the present day since he was a pioneer in the line of botanical work now known as ecology. Not only did he collect plants, but he frequently adopted the "plan of roughly mapping each day's route and indicating the plants and associations of plants along the line of march." Ecological methods, it should be remembered, were also prominent in the teaching of John Hutton Balfour.

Many passages of particular interest might be quoted from all of the chapters, but as the book to be appreciated must be read as a whole, we would rather commend it warmly to students of natural history and to those who would know of Britain's worthies. Thanks to the diaries kept by our earliest botanists and from the free use of contemporary information, the biographies are full of living personal interest. We can picture Robert Brown—facile botanicorum princeps, Britanniæ gloria et ornamentum—all the more easily and truly from the human touches in the following extracts from his diary for two consecutive days:

"Feb. 7.—Before breakfast began . . . German auxiliary verbs. . . . At dinner about 3 pints of port . . . slept in my chair till nearly 3 in the morning.

"Feb. 8.—Before breakfast finished the auxiliary verb *Seyn*; to be. . . ." A. W. H.

PRACTICAL AND THEORETICAL PHYSICS.

(1) *The Essentials of Physics.* By Prof. G. A. Hill. Pp. viii + 346. (New York and London: Ginn and Co., n.d.) Price 5*s*.

(2) *Practical Measurements in Radio-activity.* By Dr. W. Makower and Dr. H. Geiger. Pp ix + 151. (London: Longmans, Green and Co., 1912.) Price 5*s*. net.

(3) *A Systematic Course of Practical Science for Secondary and other Schools.* By A. W. Mason. Book I., Introductory Physical Measurements. Pp. vii + 126. (London: Rivingtons, 1912.) Price 1*s*. 6*d*. net.

(4) *Practical Physics: a Text-book for Technical Schools and Colleges.* By Angus McLean. Pp. xi + 402. (London: Adam and Charles Black, 1912.) Price 7*s*. 6*d*. net.

(5) *A Course of Elementary Practical Physics.* By H. V. S. Shorter. Part i., Mensuration, Mechanics, Hydrostatics. Pp. 111. Price 2*s*. Part ii., Heat and Light. Pp. 216. Price 3*s*. (Oxford: Clarendon Press, 1912.)

(6) *Lehrbuch der Physik für Mediziner und Biologen.* By Dr. Ernst Lecher. Pp. vii + 451. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 8 marks.

(7) *An Introduction to Mathematical Physics.* By Dr. R. A. Houstoun. Pp. ix + 199. (London: Longmans, Green and Co., 1912.) Price 6*s*. net.

(8) *Die Elektrizität.* By Prof. F. Adami. (Bücher der Naturwissenschaft, herausgegeben von Prof. S. Günther. 9 und 14 Band. Pp. 126 + 4 plates + 180 + 12 plates. (Leipzig: Philipp Reclam, jun., n.d.) Price 1.50 marks.

(1) OPINIONS differ as to the best mode of commencing instruction in every branch of knowledge. The correct solution of the problem is of much importance, particularly in physics, in which subject, for some reason, students seem to find more than average difficulty. The author of this book has been convinced by his teaching experience that the most efficient method of presenting the elementary principles is by means of question and answer. His book therefore consists entirely of a long series of questions. To the more difficult of these questions answers are appended; to the easier the student is expected to supply his own answers. The subjects treated are just those usual in an elementary text-book, the greatest stress, however, being laid on mechanics, to which about half the book is devoted.

While not questioning the undoubted value of question and answer in ascertaining the progress of students, it cannot be admitted that these form the function of a text-book. Question and answer should preferably be oral; they should also be mutual as between teacher and student. As a text-book the present volume is comparatively useless, principally on account of the lack of continuity and logical order which the method of presentation involves, but as a book of examples it may prove of considerable value.

(2) The appearance of a book on radio-active measurements is very welcome. That it should come from the laboratory of Prof. Rutherford, and have for its authors two such distinguished workers on radio-activity, practically ensures its general adoption in advanced physical laboratories. It can scarcely be doubted that the authors' assurance that so many and varied exercises in radio-activity can be performed with comparatively small quantities of active material will lead to the introduction of such measurements into the laboratory courses of many honours schools in physics. Most of the experiments described are already so included in Manchester, particularly with the view of the students ultimately taking up original research in this subject.

The earlier part of the book is devoted to the theory and practical use of the electrometer and various electroscopes, and the treatment is both detailed and lucid. Much useful advice in the construction of home-made instruments is given, and the student is also told how to surmount the various difficulties which arise. Chapters iii. to vi. are devoted to the practical exercises previously referred to, the number which can be performed by means of simple apparatus being surprisingly large.

The remainder of the book is intended for original investigators rather than ordinary students. Here the methods of making accurately standard radio-active measurements and the separation of radio-active substances are treated

in considerable detail. These, together with the appendices concerning radio-active constants, ranges of particles, rates of decay, &c., cannot fail to be of the utmost use to those interested in the extension of knowledge in this sphere. Lack of space forbids as detailed a description as the work deserves, but it can be confidently stated that it will prove its own recommendation.

(3) This is the first of a series of four little books on practical physics which the author proposes to publish. It is intended to form in schools a first year's course, and deals with measurements in mechanics of solids and fluids. The instructions are given in a very clear manner, and the student is told in every case exactly how to record the results. The arrangement of the book and the diagrams are excellent, rendering it quite one of the best of its kind.

(4) This is another book on practical physics, but one of a much more extensive and advanced character. The experiments described are those on general physics and properties of matter which are suitable for the advanced classes in colleges and technical schools. A knowledge of the calculus is assumed, being used for the theoretical treatment of many of the exercises. Students are instructed in the methods of eliminating errors, and advised as to the precautions necessary to secure accurate results. The author has been very thorough in this respect, and his work compares favourably with the various standard text-books of practical physics.

(5) Here is yet another book on elementary practical physics for use in schools. The two volumes deal respectively with mechanics, and heat and light. The method adopted is to ask a series of questions, the answers to some of them depending merely on theoretical knowledge and the others involving practical observations. In all cases space is provided in the book itself for the student to record the answers and results beneath the exercise itself. This certainly seems to be carrying this method of teaching a little too far, for in the case of the slovenly student the result will be that the book will be spoilt, while to the tidy student such spoon-feeding is quite unnecessary. The instructions given are rather meagre, and no diagrams are used for purposes of illustration.

(6) Dr. Lecher's book is a simple treatise on physics specially intended for students of medicine and biology. The author has endeavoured to make the subject appeal to them by the frequent introduction of illustrations drawn from their own subjects. Naturally the book is quite elementary in character, but the scope is fairly comprehensive from a descriptive point of view. Some of the diagrams are rather old-fashioned, depicting, as they do, persons performing experiments, but they are well and clearly printed, as is also the text.

(7) A book such as this of Dr. Houstoun's has long been needed. Many students of physics have experienced considerable difficulty both in selecting and in understanding the various treatises on mathematical physics which they ought to read. The present work will serve as an introduction to a variety of subjects, and the treatment is such that a student with a fair knowledge of the calculus and physics should be able to read it with comparative ease. The six chapters of the book deal respectively with attraction, hydrodynamics, Fourier series and the conduction of heat, wave motion, electromagnetic theory, and thermodynamics. There is also a series of examples at the end of each chapter. One is inclined to think that the section on thermodynamics is scarcely so extensive as the subject deserves, at any rate in comparison with the space devoted to the other sections. Standard works on thermodynamics are, however, more readily available to the average student; consequently this defect is less serious than it might otherwise have been.

(8) In this little popular treatise on electricity Prof. Adami manages to describe in non-mathematical language various principles in electricity and their applications to important practical developments. The book is nicely got up, and the diagrams are exceedingly well produced.

OUR BOOKSHELF.

The Electron Theory. By Prof. Toshinojo Mizuno. Pp. 336. (Tokyo: Z. P. Maruya and Co., Ltd., 1912.)

In this book, which is intended for Japanese readers, Prof. Mizuno, of Kyoto Imperial University, gives the substance of a course of lectures which he delivered in 1911 at the Kyoto summer school. Beginning with the vacuum tube discharge, the author leads his readers through the various phenomena associated with the Zeeman effect, Brownian movements, Lenard and Röntgen rays, up to the modern conceptions of the structure of the atom. In this connection the hypothetical forms of stable configurations are discussed at considerable length. There then follow fairly detailed sections on the constitution of the spectrum lines, on radio-activity, on the energy quantum theory, on the longitudinal and transverse mass of electrons, and the like. Towards the end the principle of relativity is introduced in connection with Michelson and Morley's classical experiments.

The author makes no claim to any originality of treatment; but he has made himself master of the growing literature of the subject and has endeavoured to give a connected view of the many phenomena described. He is not satisfied with

the present state of speculation and hypothesis, and hopes for the coming of a great mind which will unify the whole.

Luftelektrizität. By Dr. Karl Kähler. Pp. 151 (Berlin and Leipzig: G. J. Göschen'sche Verlagshandlung G.m.b.H., 1913.) Price 90 pfennigs.

THIS is one of a long series of cheap, instructive books published by the firm of G. J. Göschen. The principal contents are the earth's potential gradient, forty-four pages; the electric conductivity of the atmosphere, thirty-five pages; electric currents in the air (including the ordinary fair-weather vertical current, electricity brought down by rain and snow, and lightning), twenty-nine pages; and the radio-active phenomena of the atmosphere, twenty-eight pages. Two other shorter sections deal respectively with the electric effects of sunshine and theories as to the source of atmospheric electricity. There are eighteen figures in the text, including some interesting Potsdam records of potential gradient during calm and disturbed weather. The author is a member of the staff of the Royal Meteorological-Magnetic Observatory at Potsdam, and is a recognised expert on the subject of which he treats. Considering its size, the book gives an excellent account, clear as well as concise, of the whole subject. German results loom somewhat more largely than they probably would in a text-book written in France or England, but there are a good many references to non-German writers, including Chauveau, Simpson, and C. T. R. Wilson.

Leçons sur les Hypothèses Cosmogoniques professées à la Sorbonne. By H. Poincaré. Edited by H. Vergne. Pp. lxx + 294. Second edition, with a Portrait and a Memoir on H. Poincaré by E. Lebon. (Paris: A. Hermann et Fils, 1913.) Price 12 francs.

THE first edition of this work was given an extended notice in the issue of NATURE for May 2, 1912 (vol. lxxxix., p. vi). The present issue has been enriched by a portrait of Prof. Poincaré, and by the inclusion of a biographical notice and critical estimate of the eminent savant's work by M. E. Lebon, who has in addition made a few necessary corrections in the text.

A Manual of Agricultural Chemistry. By H. Ingle. Third edition. Pp. vii + 397. (London: Scott, Greenwood and Son, 1913.) Price 7s. 6d. net.

THE first edition of Mr. Ingle's book—reviewed in the issue of NATURE for July 10, 1902 (vol. lxvi., p. 245)—dealt with the chemistry and physics of subjects relating exclusively to English agriculture. In the present edition, however, reference has been made to the chemistry of crops of tropical and sub-tropical countries, as well as to questions of stock-feeding in other lands. In addition, the book has been revised, and to bring it up to date some portions have been re-written.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Some Phenomena Connected with Reflected X-Rays.

THE diagrams shown in Figs. 1 and 2 represent photographs obtained when X-rays were reflected on rock-salt and quartz. The spots lying on the left of the vertical line are due to the rays which have passed directly through the crystal, while those on the right are produced by reflected rays. It is easy to see from Fig. 2 that there are five spots due to the impact of the reflected rays. The middle spot and the two on the outside are more intense than the two others. The optical axis of the quartz specimen lies in this case in the plane of incidence forming an angle of 1′ with the surface of the crystal.

An explanation of the different spots of reflection shown in Fig. 2 can be given with the help of Fig. 3,

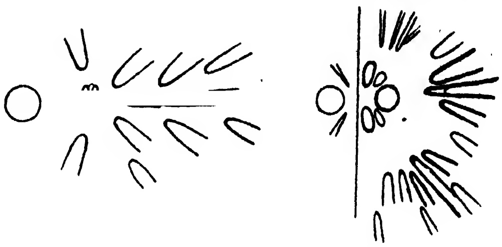


FIG. 2.

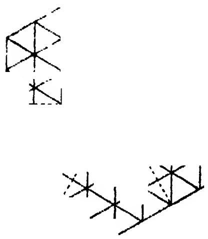


FIG. 3.

which is meant to show a cross-section of a hexagonal crystal cut at right angle to the optical axis. The points of intersection of the lines drawn in full may represent the positions of the molecules in the crystal. Considering this figure we can assume that the more intense rays are reflected by the layers which are parallel to the lines drawn in full, and the weaker ones by layers which are parallel to the dotted lines. It is obvious that in the first case the molecules lie closer together than in the second.

In addition, in Figs. 1 and 2 there are seen a series of lines which seem to converge towards the points of impact of the reflected rays, and are distributed in a way which is very similar to a spectrum obtained with visible light by means of two crossed gratings. Provided that in our case the phenomenon is due to an effect similar to that of crossed gratings, the directly reflected rays must be regarded as spectra of the order zero. On account of the diffusion of the lines, however, it is not possible at present to deduce from this the wave-length of the X-rays.

E. HUPKA.

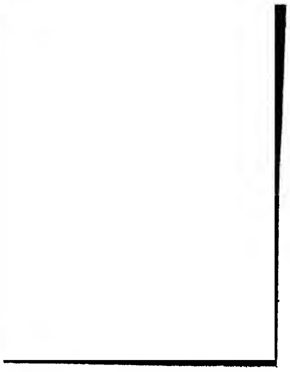
Physikalisch-technische Reichsanstalt,

Diffraction Patterns from Crystals.

THE attention given, in this laboratory and elsewhere, to the effects produced by passing a beam of Röntgen radiation through crystals suggested to me that it might be of interest to examine the image produced when a narrow pencil of ordinary light falls on a photographic plate after passing through a crystal. The lens was removed from a camera, and in place of it there was attached a tube about 30 cm. in length and 3 cm. in diameter. The tube was lined with black velvet, and provided with three diaphragms pierced with pinholes from one-half t- three-quarters of a millimetre in diameter. In thi way I endeavoured to secure that a cylindrical penc of light of small cross-section should enter th camera. In consequence of diffraction at the las aperture the impression on the photographic plate when no crystal was interposed, sometimes extende over a considerable area, resembling the diffractio images recently discussed by Mr. J. W. Gordon (Proc Phys. Soc., vol. xxiv., p. 428, 1912).

The crystal to be investigated was placed at a distance of about 5 cm. from the last aperture, an about 20 cm. from the photographic plate. The resulting image often showed lines or streaks radiating from the centre at angles depending on the crystal and its orientation. These effects are obtained only by giving a prolonged exposure or using an intense source of light. With a mercury-vapour lamp, five or six hours' exposure was given; with diffused daylight, several days' exposure was required; but by employing the direct light of an arc lamp an exposure of five or ten minutes was found sufficient.

Selenite.



Phlogopite.

I have only found such radial streaks in cases where the crystal showed a more or less streaky appearance when examined by the naked eye. It seems clear that the striations in the crystal act just like a diffraction grating. In the case of selenite the *complete* pattern resembles an eight-rayed star; the angles between the radial streaks seem to agree with the angles between the axes *a* and *c* and (possibly) the first and second median lines.

I desire to thank Dr. Sibly and Dr. Tutton, to whom some of the photographs were submitted, for crystallographic information. Dr. Tutton writes:—

"I should think the phenomenon of the streaks in the photograph is due to the well-known 'asterism.' Asterism is particularly well shown by mica, especially the variety known as phlogopite. It is due to fine enclosures arranged along the glide-planes, and parallel to the cleavage plane. It shows itself as a six-rayed star (or occasionally twelve-rayed) when the mica is held between the eye and a bright source of light. Calcite also shows asterism, certain crystals held in front of a candle flame showing a radiatin star of light. In this case, however, it is due t tubular cavities parallel to the glide-planes (the rhom bohedron known as $e\{110\}$). Some sapphires als show asterism, and here again it is due to tubula cavities in planes parallel to the prism $\{10\bar{1}\}$. I ar not aware that selenite has been studied for asterism I should think it is very likely that certain specimen will show it, those rich in cavities or enclosures The cavities would probably be parallel to the per fect cleavage plane (the symmetry plane $b\{010\}$ alon which selenite crystals are tabular), and possibly alon the two minor cleavage directions $a\{100\}$ an $n\{\bar{1}11\}$, the former of which would be parallel to th vertical axis *c*. They might also lie parallel to th inclined axis *a*. In this case your phenomenon woul be at once explained."

Although the results obtained do not reveal any nev physical phenomenon, I shall be glad if the experi ments prove of interest to the crystallographer, a affording him a convenient method of studying certai features of crystal structure.

H. S. ALLEN.

Wheatstone Laboratory, King's College, London.

Bird Protection and the Collector.

THE protection and preservation of wild birds in Great Britain is in these days beset with difficulties of many kinds; but as regards especially the preservation of the rarer birds of our country, the one great and ominous danger is the individual whom Sir Herbert Maxwell has described as "the cursed collector." At this time of the year the professional collector of eggs infests the country wherever rare species are known or discovered to breed, and wherever clutches are to be had which have their value in the market. At all seasons of the year the professional collector of birds is despoiling the land of the noble, the beautiful, the unfamiliar forms of bird-life that hide in diminished numbers among little-frequented commons and heaths, mountains and lakes, woodlands and forests, or visit the country in small numbers and nest at their peril, with a price upon their heads and upon every egg they lay.

It may indeed be said that while a percentage of naturalists are working to protect birds, to keep up the number of our native species, and to bring about some comprehension of the living creature, others are eager only to secure for themselves, by hook or by crook, the skins and feathers, and the empty shells, to fill their cabinets or to sell or barter. As one of their number has written, with unconscious irony, the preservation of a bird should begin as soon as it is killed.

A correspondent of *The Times* wrote the other day of the egg-collector:—"These pests know no boundaries and observe no laws which stand between them and the objects of their rapacity." Could the experiences of some of the workers in this society be divulged the truth of that statement might be thoroughly demonstrated. Neither the "rarity" collector who values the "British-taken" bird or egg solely because it seldom occurs or is on the verge of extinction in Britain, nor the "rarity" collector to whom the speckles on an eggshell are things of absorbing interest, will stop at any artifice or any dodge in pursuit of his quest.

The problem lies in this, that the offenders are largely men of wealth and position, officers in the Army, clergymen, "ornithologists," popularly known for their interest in bird-life, and even for their pronouncements in print on bird protection; and that these collectors not only snap their fingers at the law and take pride in evading and transgressing its pro-

visions, but employ trade agents and dealers to work for them, and give heavy bribes to poorer men—men in the responsible position of keepers and coastguards, and also fishermen, shepherds, and others whose ignorance and poverty render them easy cat's-paws. The gamekeeper receives an intimation that a certain firm of "naturalists" will be happy to hear from him with regard to certain birds or eggs which may come to his notice, and will give him handsome terms; possibly the owner of the estate inquires later on whether a notable species which he was a little proud to have on his land is still there, and is told that it unfortunately attacked the chicks and had to be shot, or, more simply, that it has "disappeared." The crofter or the fisherman is told that the rich visitor at the hotel gives a wonderful sum for such-and-such eggs, which he hears are found on a neighbouring islet or moor, or that he wishes to be taken to see a nest, and will pay his guide well; and in a few years the bird has ceased to breed in that neighbourhood.

The creation of reserves has been advocated; various areas have been described in county council orders as "protected," in which birds or eggs may not be taken. But the creation of reserves or the definition of areas will not in themselves check unscrupulous collecting. For some years this society has, with the best results, employed watchers to guard certain breeding-places of rare birds. Some score of these are scattered over Great Britain, from the Shetlands and Orkneys to Sussex and Cornwall, and more will be employed as the much-needed funds permit; but the utmost care has to be exercised in their appointment; they must have fair pay to protect them to some extent from the temptation of bribes; and members of our watchers' committee visit their stations from time to time to inspect and judge actual results. Brean Down, of which the society rents the shooting rights, we hope to make a complete reserve for birds. It is exceptionally well suited for the purpose, and cannot well be visited without the knowledge of the watcher. Dungeness is a "protected area" guarded by the society's watchers during the breeding season. Yet at Dungeness a collector took advantage of a permit obtained by an unsuspicious friend to pocket all the eggs he could seize upon; followed by a watcher he was compelled to disgorge and restore every one. At Brean Down last spring the solitary young bird was taken from the peregrine's eyrie; an honorary watcher, discovering what had happened, pursued the culprit by motor-car, obtained the bird, brought it back to the down, and with considerable difficulty restored it to the nest.

On a protected island, a few seasons ago, permission to view was again gained by stratagem, and the visitor, closely followed, was at last impelled to say that "it was a pity to leave such nice eggs," and he would stand the consequences of taking them; the consequences happily worked out at 1*l.* per egg, and the eggs were forfeited. In Scotland the society has had to employ detective-inspectors, whose work called for vigilant circumspection. In Wales the kites' nests have to be guarded day and night. In many cases the eggs of harriers, ravens, peregrines, and other species are taken year after year, so that no young bird is ever reared, and only the presence of keen and determined watchers can stop this, or prevent the destruction finally of the parent birds. To the collector the idea of extermination of a species can suggest no regret; it would but add to the value and interest of his specimen.

Reserves and county council orders are admirable in intention; the latter are useful as affording possibility of conviction and fine where offenders are caught in the act. But as deterrents they avail nothing for persons of this class, and unless carefully worded may indeed serve to advertise the presence of a rare species. A law to deal with possession and the possessor is now absolutely necessary, as well as a strong public opinion which shall cause these collectors to be held in the contempt they deserve and shut them out from the society of decent naturalists. One proposal as to the kind of law needed has been made by Mr. W. H. Hudson ("Birds and Man," chap. xii.):—

"There is really only one way out of the difficulty—one remedy for an evil which grows in spite of penalties and public opinion—namely, a law to forbid the making of collections of British birds by private persons. . . . Without such a law it has now become impossible to save the best of our wild bird-life."

The words are even more true now than when they were written, and the time is more ripe for translating them into action. The old idea that not only must the ornithologist make collections, but that collections make the ornithologist, is giving way before the nature-reserve and the nature-student. But if the nature-reserve and the prohibition to take rare birds and rare eggs are to be more than a comfortable delusion, the open advertisement and the secret circular, the open incentive and the secret bribe for "procuring" specimens and for harrying nests, must be put a stop to. The source and motive, the *fons et origo*, of all these things is the private collection.

L. GARDINER,
Secretary, Royal Society for the Protection of Birds.
23 Queen Anne's Gate, London, S.W.

Mechanically-formed Grikes in Sandstone.

IN the Lower Old Red Sandstone of the west of Caithness I have noticed an appearance which recalls the grikes due to erosion of which Mr. Carus-Wilson writes in NATURE of May 1. It is seen in the platform of marine denudation in a minor inlet on the north coast at the village of Reay, eleven miles west of Thurso. The dip of the rocks varies from 10° to 30°, averaging 17°, 10° west of north, and the low scarps, lying transverse to the axis of the bay, run down to the sea, giving rise to the tiny inlets locally known as "ports," or "porties."

At the harbour begins a thick sandstone, stretching in a southerly direction to a thickness of about 120 ft., which appears to pass laterally into the grey and blue flags so prevalent in the area. Separated from the main body of the sandstone by a flaggy sandstone and blue flag is the thin sandstone in which the "grikes" are seen.

There does not seem to be any lithological difference between the rock of the main body and that of the layer with the "grikes." Both are grey sandstone, which weathers to a light reddish-brown colour, and there is an appreciable amount of hæmatite present surrounding the quartz grains which make up the bulk of the rock. Felspars are fairly numerous and fresh, and there are wisps both of muscovite and biotite. The cement is largely micaceous, but calcite is present, and there has been some deposition of quartz from solution. The quartz grains are not well rounded.

The grooves are smaller than those Mr. Carus-Wilson mentions; the largest are about a foot deep and four inches wide, but the length of the longest is well over 16 ft. They run in two directions at right angles, parallel to the dip and strike, and the network is at places so fine that miniature stacks stand out, about 4 in. square in section.

As the place is about 40 yards below the beach of

very coarse shingle one turns from the erosion hypothesis, and the slightly pitted nature of the rock surface suggests solution. ALEX. STEVENS.

Geological Department, University of Glasgow, May 6.

The Mountains and their Roots.

MAJOR COWIE's letter in NATURE of May 8 gives the impression that I had the facts of the observations on the deflection of the plumb-line in India before me, and that I made my assumptions as to relative densities, and the mode of compensation by extension of depressed crust beneath the plains, "suitably adjusted," so as if possible to bring out the desired results. This was not the case. *I made the assumptions about relative densities which seemed to be a priori probable*; and it will be seen from the diagram at p. 184 of my "Physics of the Earth's Crust" that fifteen years before I wrote the paper in the *Phil Mag.* I had suggested that compressed mountains would be partly supported by an extension of the depressed crust beyond them.

Should anyone be inclined to undertake the labour of calculating from my formulæ, introducing fresh constants, or other distances, I would warn him that in the *Phil. Mag.* there is a misprint. In the formula for the plateau, after the first bracket, insert x.

I am much pleased that after so long a time my theories are under discussion, and I hope to come well out of it. I am sending to the *Geological Magazine* a reply to some remarks by Sir T. H. Holland in that journal, and to this I would refer your readers as more fully giving my views on some of the points under discussion. O. FISHER.

Graveley, Huntingdon, May 9.

An Application of Mathematics to Law.

I HAVE read Mr. Potts's letter in NATURE of April 24, but am at a loss to understand the use to which he would put his equations.

If it be his object to find some equation giving the validity of a patent or foretelling in any way the probability of its being upheld in a court of law, he has clearly failed to do anything of the sort.

If his equation $I = M + i$ is to be of any value, the quantity i must have a fixed value greater than zero. In fact, however, for any given patent, i may have an infinite number of values, including zero, since each person will have his own idea of the amount of ingenuity that must be shown in the particular case by the inventor. Thus the inventor will certainly put a high positive value upon i, while his opponent will as certainly say that the value of i is zero. It is clear that the value of i can only be finally settled when the validity of the patent has been settled by the House of Lords, and at this stage of a patent's career it is scarcely necessary to have an equation to test its validity. So far as the rest of his letter goes, he seems to have chosen a rather complex method of setting out a few of the chief principles of patent law. R. STAFFORD CRIPPS.

Fulmer, Slough.

I DID not imagine that my letter would be taken as an attempt to supersede the present methods of determining validity. I intended it as a contribution to the theory which underlies the enormous volume of our case-law on the subject. Surely, as in other cases of the progress from empiricism to science, the first step must be in the direction of mathematical or symbolic expression of the facts. The value of such a symbolism is twofold: first, as an aid to precision of thought; and second, as a preliminary to generalisation. It is a vital principle of English law that all decisions shall harmonise with precedents as much as possible, and on this account alone anything should be of value which assists in formulating generalisations. We admit the value of theory in the physical sciences, apart from immediate practical results: why should an attempt to develop a theory of law be condemned because it does not at once do away with the functions of the judge?

Mr. Cripps's difficulty as to the value of i will not be so great if the actual cases given in my letter are studied. I may add here, however, that it is immaterial what this value is, provided that it is measurably greater than zero. It is settled law that a *scintilla of ingenuity* is sufficient to support a patent *for something new and useful* (*cf.* Thompson *v.* Amer. Braided Wire Co., in the House of Lords, and other cases). I therefore employed this symbol merely to indicate that there had to be some positive difference. HAROLD E. POTTS.

University Club, Liverpool.

SYNTHETIC BIOLOGY AND THE MECHANISM OF LIFE.

THE presidential address delivered by Prof. Schäfer to the British Association in 1912, and the subsequent independent discussion at a joint sitting of two of the sections, served, as was pointed out by Prof. Armstrong in a paper in *Science Progress* in October last, "as a useful corrective to the wave of vitalism that has passed over society of late years owing to the pervasive eloquence of Bergson and other writers." Probably the majority of those who have studied the phenomena of life from the chemical side will agree with Prof. Schäfer in his dictum that "at the best vitalism explains nothing," and accept his opinion "that we may fairly conclude that all changes in living substance are brought about by ordinary chemical and physical forces." The difficulty, however, lies in obtaining any satisfactory information as to what are the actual chemical or physical changes which occur in the real living cells or tissues. Since this discussion was held Prof. S. Leduc, of the School of Medicine at Nantes, has published a monograph[1] in which he approaches the problem from the novel point of view which now for several years past has guided his experiments and with which readers of his "Mechanism of Life" will be familiar.

It is impossible to do justice to the author's arguments or make clear the proper value of his demonstrations in a short article such as the present, but this will at least serve to direct attention to a few of the very remarkable results that he claims to have achieved, which, if verified, are certainly of the highest significance to the student of the phenomena of life.

The basis of Prof. Leduc's work may be summarised in his own words as follows: "It is in the physico-chemistry of liquids that an explanation of the phenomena of life is to be sought"; and he develops his views largely by studying the nature of diffusion in liquids and the phenomena

[1] "La Biologie Synthétique." By Prof. Stéphane Leduc. Pp. ii + 217 (Paris: A. Poinat, 1912.)

that are thereby produced. He regards diffusion as brought about by currents which radiate to and from the centres of greatest concentration; when a drop of solution of higher concentration is placed in a solution of lower concentration, the drop becomes the centre of symmetrically radiating currents, the one set, consisting of the solution of higher concentration, radiating outwards (centrifugal), the other set (centripetal) radiating inwards and consisting of the solution of lower concentration. "The force producing the currents is the osmotic pressure. Their centres of emission, true dynamic centres or poles, are of two kinds: centres of osmotic pressure greater than that of the medium or positive poles of diffusion, and centres of lower osmotic pressure or negative poles of diffusion. Around these poles of diffusion the dynamic and kinetic phenomena are the same as those which exist in the æther around electric or magnetic poles; the same mechanical laws control them, and a molecule is displaced in the liquid exactly like an ion in an electric field." Photographs are given by Prof. Leduc which show that, for example, a drop of tinted water diffuses into a saline solution along lines which exactly correspond with the discharge from an electric point or with the lines of force from the pole of a magnet. "It is the graphical representation of a centre of force such as was demonstrated by Faraday." Concentric circles of concentration are produced by diffusion which correspond with Faraday's equipotential surfaces.[2]

By utilising differences of concentration and the accompanying osmotic and chemical phenomena under different conditions and with different substances and media, Prof. Leduc states that he has been able to reproduce many phenomena which have hitherto been regarded as characteristic exclusively of living matter. Of a few of these a brief description is appended.

Cell Synthesis.—Of the many different types of cell which Prof. Leduc states that he has "synthesised," the photograph, Fig. 1, shows three varieties: A is an artificial cell produced by a drop of solution of triammonium phosphate in a solution of sodium carbonate and trisodium phosphate; the "nucleus" is large and the analogues of the protoplasmic processes and the enveloping membrane thick. The middle figure B is an artificial aster produced by a drop of water tinged with Indian ink in a solution of potassium nitrate. C shows an artificial cell with interior granulations. When such cells are prepared with a precipitated membrane composed, for example, of calcium carbonate or phosphate, they grow in size owing to the fact that the centripetal diffusion (of water) is greater than the centrifugal, the surrounding membrane becoming correspondingly extended.

Karyokinesis.—The reproduction artificially, by very simple means, of all the phenomena characteristic of karyokinesis is one of the most striking achievements to which Prof. Leduc lays claim. The photograph (Fig. 2) shows four successive periods of cell-division reproduced by diffusion. "If in a saline solution there is introduced between two tinted drops, of less or greater concentration than the solution and representing the centrosomes, a drop of solution very slightly more or less concentrated than the solution and representing a nucleus, all the transformations, all the movements,

and all the figures characteristic of nuclear division are seen to unfold themselves in their proper sequence and regular order." In the figure A shows the spirem stage, B the orientation of the chromatic substance in the equatorial plane, C the chromosomes on their way to the centrosomes, and D the two final cells produced as a result of the action.

Multiplication.—If an artificial cell is kept for a sufficient time in the liquid from which it has been formed, after a time a furrow appears in the interior of the cell and later other furrows

FIG. 2.

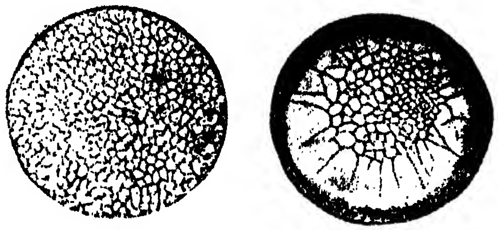
appear which split up the cell into secondary cells, the number of which rapidly increases until the artificial cell becomes nothing but a group of secondary cells—that is, an "artificial morula." Fig. 3 shows a comparison of the germinative disc of a hen's egg (A) with the segmentation of an osmotic cell produced artificially.

Nutrition and Development.—In a chapter on the physiology of nutrition, illustrated by a number of striking photographs which we cannot reproduce here, Prof. Leduc contends that the "facul-

[2] Reference may here be made to a paper by Dr. Horace T. Brown and F. Escombe on static diffusion of gases and liquids, &c. (Phil. Trans., 1900, 193 B, 223), which is not referred to by Prof. Leduc, but substantially corroborates his views on these points. In this paper it is shown that the lines of flow of gas or solute diffusing through a perforated diaphragm are the analogues of the lines or tubes of force, and the shells of equal density or concentration obtained the analogues of electrical surfaces of equipotential.

ties of nutrition, absorption, elaboration or chemical metamorphosis, assimilation, elimination, growth, development, functional differentiation, organisation, inanition and disease are shown by osmotic growths exactly as by living organisms." Striking examples of a comparatively high degree of organisation are given in the chapter on "morphogeny," such, for instance, as the capsular terminations of the filament-like growths obtained with manganese salts, or the "osmotic fungi" which very closely resemble natural fungi in their appearance and structure. One of the most interesting features of these growths is the selective distribution of colour in the different parts, one portion of which may be, for instance, greenish-white, another light green, another part dark green and other parts golden yellow.

Phototropism, galvanotropism, &c.—Prof. Leduc contends that the majority of such phenomena as phototropism, chemotropism and galvanotropism, which have been regarded as essentially vital phenomena, can be artificially reproduced with purely mineral or unorganised material. If, for example, a bath of a salt solution is placed so that one half is illuminated and the other half



A B
FIG. 3.

is in darkness, and a drop of water tinted with Indian ink is added, "the particles of carbon abandon the illuminated portion and take refuge in the dark part." These and similar results are utilised by Prof. Leduc in a discussion of the nature of the changes occurring in the production of sense impressions. One of the most striking phenomena in this domain, the deformation of the ovule, with the production of a protuberance on the side of the spermatozoid, which Sachs called "the most surprising phenomenon in fecundation," Prof. Leduc claims to have reproduced artificially in a very simple way: If near an artificial cell (hypotonic), produced in a non-saturated solution of potassium nitrate, a small crystal of potassium nitrate be placed, not only is the artificial cell deformed with a protuberance on the side of the crystal, but the lines of circulation within the cell are evidently also influenced.

In this small treatise 118 photographs are reproduced, each of which is said "to be expressive of a fact and to represent the result of a series of experiments." It has here been possible only to outline in the most general manner the character and scope of the work. W. A. D.

SEMI-CENTENNIAL CELEBRATION OF THE NATIONAL ACADEMY OF SCIENCES IN WASHINGTON.

THE National Academy of Sciences of the United States celebrated the fiftieth anniversary of its foundation on April 22–24 at Washington. A special programme was arranged, and many distinguished guests were invited to participate in the celebration. In recognition of the function of the academy as the scientific adviser of the Government, President Wilson, Vice-President Marshall, and Chief Justice White took part in the exercises.

The celebration was held at the Smithsonian Institution, and began on the morning of April 22 with an address by the retiring president of the Academy, Dr. Ira Remsen, who reviewed the history of the organisation and gave an account of the scientific labours of the incorporators, and of the various trust funds of the academy.

Dr. Remsen was followed by President Hadley, of Yale University, whose theme was the relation of science to higher education in America. An address was then delivered by Dr. Arthur Schuster, F.R.S., on international cooperation in research. After a luncheon the academy and guests listened to a brilliant lecture by Dr. G. E. Hale, director of the Mount Wilson Solar Observatory, on the earth and sun as magnets. The lecture was illustrated by lantern-slides and experiments. In the evening a reception was given by the regents and secretary of the Smithsonian Institution, the hosts being Vice-President Marshall and Chief Justice White, Chancellor of the institution.

On the morning of April 23 an address was delivered by Dr. J. C. Kapteyn, director of the astronomical laboratory of the University of Groningen, on the structure of the universe. In the afternoon the academy and guests assembled at the White House, where certain medals and prizes of the academy were presented by President Wilson. Dr. R. S. Woodward, director of the Carnegie Institution of Washington, read the reports of the committee on the awards, after which the President handed the medals and prizes to those who were to receive them, or to their representatives, prefacing his action by brief remarks in which he gracefully referred to the academy as a great society, and as one long associated in an advisory capacity with the Government of the United States. The awards were as follows:—

The Watson medal to Dr. J. C. Kapteyn in recognition of his bold, penetrating researches on the problem of the structure of the stellar universe. Dr. Kapteyn received the medal in person.

The Henry Draper medal to M. Henri Deslandres, of Meudon, France, for his noteworthy researches in astrophysics. M. Deslandres not being present, the medal was delivered to the French Ambassador, M. Jusserand.

The Agassiz medal to Dr. Johan Hjort, of Bergen, Norway, for his meritorious contributions

to the science of oceanography. In the absence of Dr. Hjort, the medal was received by the Norwegian Minister, Mr. Bryn.

The Comstock prize of 1500 dollars to Prof. Robert A. Millikan, of Chicago, for his demonstrations of the existence of electric atoms in elements and of the equality of the electrical charge of positive and negative ions in ionised gases, and his additions to the knowledge of the molecular constitution and kinetic phenomena of gases.

A business meeting was held on the morning of April 24, when the following officers and new members and foreign associates were elected: *President*, William H. Welch; *Vice-President*, Charles D. Walcott; *Foreign Secretary*, George E. Hale; *Home Secretary*, Arthur L. Day; *Treasurer*, Whitman Cross. *New Members:* Henry A. Bumstead, Gilbert N. Lewis, Louis V. Pirsson, Erwin F. Smith, Leonard E. Dickson, Lafayette B. Mendel, Edward B. Rosa, Ross G. Harrison, George H. Parker, Armin O. Leuschner. *New Foreign Associates:* Arthur Schuster, Theodor Boveri, William Crookes, Gaston Darboux, Henri Deslandres, Albert Heim, Albrecht Kossel, Karl Friedrich Küstner, Johannes D. van der Waals, August Weismann, Max F. J. C. Wolf.

On the afternoon of April 24 an excursion was made to Mount Vernon on the U.S.S. *Mayflower*, which had been placed at the disposal of the academy and its guests by the Secretary of the Navy. In the evening a banquet was held in the New Willard Hotel, at which speeches were made by Vice-President Marshall, the Right Hon. James Bryce, President Remsen, Dr. S. Weir Mitchell, Senator T. E. Burton, of Ohio, and Dr. W. W. Keen, President of the American Philosophical Society.

To mark the anniversary, the academy published a history of its first half-century in a handsome volume of some 400 pages. It includes an account of the founding of the academy, its annals, biographical sketches of the incorporators, and a chapter on the work of the academy as the scientific adviser of the Government, together with appendices, among which is a list of publications.

SCALES OF FISH AS TESTS OF AGE.

THE general principle that the age of a fish may be determined by a study of the markings on the scale has now been generally accepted for many fishes, especially for the Gadoids, Clupeoids, and Salmonidæ. It has been maintained, especially by Norwegian naturalists, that the principle may be carried still further, and that from a measurement of the portions of the scale representing the growth of successive years the length of the fish at the end of each year of its life may be calculated. If this proved to be true, the average annual growth rate of fishes could be determined by the examination of comparatively small samples of fish, since each of the older fishes would give values for a number of years.

That the use of the method in this way must be undertaken only with great caution is clearly shown in a paper by Miss Rosa M. Lee, published by the International Council for the Study of the Sea (*Publications de Circonstance*, No. 63), entitled "An Investigation into the Methods of Growth Determination in Fishes." By an acute and penetrating analysis of the measurements of scales from herring, haddock, and trout, Miss Lee shows that if the lengths of the fish at the end of each year are calculated from the lengths of the annual rings on the scale, measured from the centre of the scale along its major axis, the figures obtained appear to indicate a change in the growth rate of such a nature that the younger fishes attained a greater size at any given age than was attained by older fishes at the same given age. Thus whereas in a sample of herrings the four-year-old class gave an average calculated length of 25·8 cm. at the end of the third year, the ten-year-old class gave an average calculated length of only 21·3 cm. at the end of their third year.

Various hypotheses are put forward to account for this phenomenon, of which the most probable seems to be either that it is due to an actual shrinkage during the later life of the fish of the portion of the scale already laid down, or that in the samples of fish examined there has been a segregation according to size of such a character that only the larger sizes of the earlier age groups are present. The subject is clearly one which must be further investigated before certain conclusions as to age can be arrived at from the study of fish scales.

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual May conversazione of the Royal Society was held in the rooms of the society at Burlington House on Wednesday, May 7. During the evening lantern demonstrations were given by Mr. Leonard Bairstow illustrating cases of eddying fluid motion of interest in aëronautical research, and by Dr. A. Smith Woodward on the discovery of a palæolithic human skull and mandible at Piltdown, Fletching, Sussex. Many objects and instruments illustrating recent scientific methods and results were exhibited, and most of them are described in the subjoined summaries from the official catalogue. Exhibits referring to related branches of science have, so far as possible, been grouped together.

Prof. J. T. Morris: The electrical measurement of wind velocity, as applied to the distribution round a circular rod in an air current. In the air current is fixed a Wheatstone bridge made with alternate arms of platinum and manganin. At normal temperature this bridge is out of balance. It is supplied with either (*a*) a constant voltage, when a millivoltmeter in place of the usual galvanometer gives indications depending on the wind velocity; or (*b*) a current which can be varied so as to bring the bridge into balance for any velocity; the square of the watts used in the bridge wires is then proportional to the wind velocity subject to a small correction. It is unnecessary to know the direction of the wind before a measurement can be made. *Mr. M.*

O'Gorman: Instruments for aëronautical work and research on aëroplane stability. (1) Ripograph to record velocity, roll, pitch, yaw, and the corresponding movements of the flyers' controls on a continuous photo-strip. (2) Velometer: to indicate speed through the air of aëroplanes and airships. (3) Trajectograph: to record the path through the air of aëroplanes. (4) Air distance recorder or log: to give miles passed through the air of aircraft. (5) Recording accelerometer. (6) An airship and aëroplane instrument board complete. (7) Tautness meter: to enable the pull on a wire to be measured without altering or cutting it, or putting fixtures on the wire. Suitable for using during flight. *Mr. J. D. Fry:* A micromanometer capable of detecting differences of pressure of the order of one-millionth of a millimetre of mercury. The difference of pressure to be measured is applied to the two sides of a stretched membrane; the centre of the membrane by its displacement twists a mirror which is suspended in a special manner, the pressure differences being indicated by the deflection of a spot of light. *National Physical Laboratory:* Apparatus for the rapid determination of the lifting power of samples of hydrogen. (*Mr. Guy Barr.*) The method employed depends on the principle of balancing columns commonly used for comparing the densities of liquids. From the reading of a gauge, when the pressure difference is balanced, the lifting power of the hydrogen is determined with an accuracy of about 0·02 per cent. From the lifting power the purity of the hydrogen may be deduced by making corrections to N.T.P. after observation of the volume of a known mass of air.

The Cambridge Scientific Instrument Company, Limited: (1) Apophorometer: an instrument designed by Prof. J. Joly, for easily obtaining sublimates from substances at high temperatures. (2) Rack barometer: a barometer of the marine type, in which a dial is substituted for the vernier in general use. The dial is divided to read directly in tenths of a millibar. (3) Stomatograph: an instrument which records the amount of opening of the stomata on a leaf. (4) Yaw indicator: this instrument is designed to indicate the direction of a current of gas in any plane. *M. C. V. Boys:* Rainbow cups—old and new patterns. The chief characteristic of the new pattern is the point support of the cup. The accurate work necessary with an axle is avoided and the friction is greatly reduced. The cup supported at a point is free to precess, and during this motion the coloured rings appear to expand and contract in time with the precession. The direction of precession is opposite to that of an ordinary top. *Sir John Thornycroft:* Model to illustrate the effect of a compound cross sea on vessels of various rolling periods. In the model a plane surface is supported on three points, two of which move vertically and the third is stationary. In the vertical motion of each of the two moving supports four simple harmonic motions are combined, and the phase of motion in the two differ by a quarter of their time period, and produce in the moving surface a symmetrical motion, resembling that of a small portion of a complicated sea in which similar waves are crossing at right angles. *Mr. R. E. Gillmor:* The Sperry gyro compass. To be efficient the gyro compass must be so suspended that there is almost an entire absence of friction about the vertical axis, while at the same time forces must be impressed upon the wheel itself about the horizontal and vertical axis to cause the wheel to rotate into the plane of the earth's rotation. In the Sperry compass both are accomplished by suspending the gyroscopic or sensitive element from a stranded wire, the top of which is held in a frame surrounding the sensitive element and made to follow it by a system of electrical contacts controlling a motor which drives the frame.

Underfeed Stoker Company, Ltd.: CO_2 thermoscope, a self-contained pocket instrument for the thermometric analysis of carbonic acid gas in furnace and other gases. The instrument operates by measuring the heat of reaction between CO_2 and dry pulverised caustic alkali. (See NATURE, April 17, p. 171.) *Mr. F. W. Jordan:* Convection radiometer and thermo-galvanometer. This instrument is primarily intended for the measurement of feeble steady rates of evolution or absorption of heat. *Mr. Dugald Clerk:* Determination of the volumetric heat of air, carbon dioxide, nitrogen, and flame in the cylinder of the internal-combustion engine. The volumetric heats of various gases and flames have been determined by the method of alternate compressions and expansions described in a paper read before the society in 1906. The present investigation deals with gases at low and high temperatures, and gives values between 100° C. and 1000° C. Laws of cooling have also been investigated, and the remarkable effect of turbulence on the rate of flame propagation in engines has been demonstrated. *Prof. Leonard Hill:* Kata-thermometers or comfort-meters. Two large-bulbed spirit thermometers are used. The bulb of one is surrounded with muslin. The stem of each is marked with heavy black lines at 110° F., 100° F., and 90° F. Readings can be taken with the bulbs of the instruments (1) clothed; (2) exposed or shielded from radiant heat, *e.g.* a fire. By this means the heating and ventilation of rooms and the effect of clothes can be investigated and arranged so as to give (1) comfortable loss of body heat; (2) prevent depressing effect of uniformly heated air on cutaneous nerves. *Prof. L. R. Wilberforce:* Experiments with ripples. Ripples produced on a water surface by a vibrating dipper are projected by intermittent light so as to appear stroboscopically in slow motion. A phonic wheel drives the slotted disc which produces the intermittence, the motion being transmitted by fluid friction whereby a very uniform rotation is obtained.

Mr. E. Leitz: Ultra-condenser for the observation of ultra-microscopic particles. The ultra-condenser has been devised for ultra-microscopic observations, especially in the examination of fluids and gases. The condenser renders any ordinary microscope suitable for the purpose. It consists of two glass bodies, each having a reflecting spherical surface, cemented into a metal box fitted with a bayonet-jointed and rubber-faced cover. The cover is fitted with a disc of quartz which serves as a cover glass. Underneath, the cover glass has a cavity for receiving the liquids and gases for examination. The condenser is not intended for high-power observations, and therefore objectives of shorter focal length than 8 mm. may not be used. *Prof. J. Norman Collie and Mr. H. S. Patterson:* The presence of neon and helium in hydrogen after the passage of the electric discharge through the latter at low pressures. Whatever the explanation may be of the presence of neon and helium in hydrogen after the latter has sparked it seems to be certain that:—(1) Neon and helium cannot be obtained from either glass or from the electrodes by heating alone; (2) glass, when heated to near its softening point and subjected to the action of kathode rays, is not permeable to neon or helium, so neither neon nor helium diffuses into the apparatus from the atmosphere. *Mr. A. Fowler:* New lines in the spectrum of hydrogen. Certain lines which occur in the spectra of stars and nebulæ have been attributed to hydrogen by Pickering and Rydberg in consequence of numerical

relationships with the well-known Balmer series. Some of these "cosmic hydrogen" lines have lately been produced by passing a strong condenser discharge through a mixture of hydrogen and helium. *Prof. H. H. Turner:* Diagram of sun-spot analysis. Wolf's sun-spot numbers 1750–1910 can be closely represented by the harmonics of a period of 156 years, the coefficients of which rise and fall in a regular manner. The familiar 11⅛ year period is the fourteenth harmonic, and has the maximum amplitude; but periods near it, especially thirteen and fifteen, are also important. All the chief harmonics were determined approximately, and their sum is compared with the numbers showing that the residuals are small. *Capt. H. G. Lyons:* An ancient Egyptian astronomical instrument. The original of this instrument was found in Upper Egypt, and is now in the Royal Museum at Berlin. By means of the wooden "sight-vane," one observer aligned the plumb-line, which was held by a second observer, on the pole-star. The second observer then noted the passage of certain stars over the first observer's head, and thus determined the divisions of the night.

The National Physical Laboratory: Specimens illustrating the behaviour of metals at relatively high temperatures. (*Dr. Rosenhain and Mr. Ewen.*) In researches on the intercrystalline cohesion of metals their behaviour at temperatures near their respective melting points has been examined, both by heating *in vacuo* and by mechanical tests. The volatilisation which occurs in many metals at temperatures below their melting points results in the formation, on previously polished surfaces, of patterns corresponding to the structure of the metal. This constitutes a process of vacuum etching. *Prof. W. J. Pope:* A collection of artificial crystals. A number of large crystals of various salts prepared by slow crystallisation of aqueous solutions; most of the crystals are well-proportioned, and peculiarities of face development, &c., can be observed upon them.

Prof. E. B. Poulton: All-female families and mixed families of *Acraea encedon,* bred by Mr. W. A. Lamborn in the Lagos district. These researches indicate the existence of two castes of females, one of which produces mixed families and the other all-female families. Both require fertilisation. *Mr. L. Doncaster:* The moth *Abraxas grossulariata*: inheritance of tendency to produce unisexual broods. In six successive generations families consisting wholly of females have appeared. *Dr. S. F. Harmer:* Polyzoa of waterworks. (See NATURE, May 8, p. 260.) *Dr. W. S. Bruce, Scottish Oceanographical Laboratory:* Collection of deep-sea animals taken by the *Scotia,* Scottish National Antarctic Expedition, 1902, 1903, and 1904. While a few of the animals shown are representative of shallow-water antarctic fauna, the greater number are from depths down to 2645 fathoms, or about three miles. An important feature of the scientific results of the *Scotia* lies in the fact that the Scottish expedition was the only antarctic expedition which has been completely fitted for deep-sea research in high southern latitudes. *Marine Biological Association of the United Kingdom:* Living crabs and their allies arranged to show some of the various modifications of form and structure found in this group, and the relation between such modifications of structure and the mode of life of the animals. *Mr. Conrad Beck:* Marine Coscinodiscus showing filaments, shown under the microscope with high-power dark ground illuminator (mounted by H. J. Waddington). The filaments radiating from these diatoms were discovered by Mr. Siddall of Chester, and some controversy has arisen as to whether they are protoplasmic, pseudopodia, or silicious spines. They are readily seen with a low power, but require very oblique dark ground illumination, as used for high powers, to demonstrate them. *Mr. C. B. Williams:* British Protura. The Protura, first described by Silvester from Italy in 1907, and first recorded from England last year by Mr. Bagnall, are a group of primitive Arthropods the systematic position of which has been the subject of much discussion. Their chief affinities are with the Insecta or with the Myriapoda, and they have been considered by various authorities as members of these groups and as a separate class intermediate between the two. *Mr. H. G. Plimmer:* Blood parasites: new, or from new hosts.

Dr. S. Watson: Skull, mandible, shoulder girdle, and forelimb of Dicynodon, sp. nov. female individual. *Dr. D. H. Scott:* Sections of Upper Devonian plants showing structure. *Keeper of Geology, British Museum (Natural History):* Remains of a Palæolithic human skull and mandible, with flint implements and mammalian teeth, from a gravel at Piltdown, Fletching, Sussex. This collection was made by Mr. Charles Dawson, and is described by Messrs. Dawson and A. Smith Woodward in the Quarterly Journal of the Geological Society for March, 1913. The skull and mandible are regarded as representing a new genus and species of Hominidæ, named *Eoanthropus dawsoni. Prof. G. Elliot Smith:* The brain-cast obtained from the Piltdown skull, and other specimens for comparison. The cranial cast obtained from the Piltdown skull was shown alongside a series of specimens and drawings illustrating the form and constitution of the brain in primitive men, anthropoid apes, and other mammals supposed to be near the line of human ancestry. The objects of this comparative series are (1) to illustrate and help in the interpretation of the distinctive features of the most primitive human brain to which we have access at present, and (2) to elucidate the nature of the evolutionary process by which the human brain has been derived from that of an early mammal. A specimen was shown representing an attempt at the restoration of the features of the Piltdown man's brain. *Mr. Henry Balfour:* Stone implements of Early Palæolithic types from South Africa. A selected series of stone implements from South Africa, exhibiting marked similarity in form and technique to the Chellian and Acheulian implements of the Lower Pleistocene river-gravels of England and western Europe. The implements exhibited were collected partly in the neighbourhood of Kimberley and partly on the Zambezi (Victoria Falls) and the Maramba River. *Mr. C. Forster-Cooper:* Remains of fossil mammals from the Early Miocene deposits of Dera Bugti in Baluchistan. The bone beds around Dera Bugti are interesting from the fact that they contain the earliest remains of mammals as yet discovered in the East. From their situation on the probable line of migration from or to Europe and Africa, it is hoped that interesting comparisons may be made with the earlier or contemporaneous faunas of Europe and Africa. *Mr. H. Peake and Mr. E. A. Hooton:* Skulls and grave furniture from Saxon graveyard at East Shefford, Berks, explored 1912. This graveyard was discovered in 1890 during the construction of Lambourne Valley Railway. It was carefully explored in September, 1912, when twenty-six graves were found. It seems to date from the early part of the sixth century. *Prof. E. Hull:* Coloured map of the North Atlantic and bordering regions to show the submerged terraces and river valleys as determined by the soundings of the Admiralty charts.

NOTES.

THE Bakerian lecture of the Royal Society will be delivered by Sir J. J. Thomson, O.M., F.R.S., on May 22, upon the subject of "Rays of Positive Electricity."

DR. GISBERT KAPP, professor of electrical engineering in the University of Birmingham, has been appointed president of Section G (Engineering) of the British Association for the meeting to be held in Birmingham in September next.

THE Georg Neumayer gold medal was bestowed upon Prof. L. A. Bauer, director of the department of terrestrial magnetism, Carnegie Institution of Washington, for his various researches in terrestrial magnetism, at the celebration of the eighty-fifth anniversary of the Berlin Gesellschaft für Erdkunde, on May 3.

THE Newcastle City Council has decided to invite the British Association to meet in Newcastle in 1916. A deputation consisting of the Lord Mayor (Alderman J. F. Weidner), the Sheriff (Mr. G. T. de Loriol), and Sir W. H. Stephenson was appointed at the meeting of the council on May 7 to present the invitation at the meeting of the association in Birmingham next September.

THE first Wilbur Wright memorial lecture will be delivered by Mr. Horace Darwin, F.R.S., at the Royal United Service Institution, Whitehall, on Wednesday, May 21, at 8.30 p.m., under the auspices of the Aëronautical Society, which has raised a fund for the annual delivery of a premium lecture in order to commemorate the work of Wilbur Wright, who, with his brother Orville Wright, evolved the first successful power-driven aëroplane which carried its pilot.

THE Walker prize, which is awarded by the Boston Society of Natural History once in five years, has been awarded this year to Mr. Robert Ridgway, of the United States National Museum, in recognition of his investigations in ornithology, and particularly for his work on the birds of North and Middle America. This prize, the amount of which is 200*l*., was, says *Science*, founded by the late Mr. W. J. Walker, a benefactor of the society, and is given in recognition of important investigation in natural history published and made known in the United States of America.

THE death is reported, in his seventy-eighth year, of Mr. W. M. Fontaine, a leading American authority in fossil botany. A Virginian by birth, tracing his descent from a Huguenot family, he fought on the Confederate side in the Civil War. He was afterwards professor of chemistry and geology at the West Virginia University, and later held the chair of geology and natural history at the University of Virginia for thirty-three years, retiring in 1911 with a Carnegie pension. Prof. Fontaine took part in the second Pennsylvania Geological Survey, and at various times contributed reports to the U.S. Geological Survey.

THE latest ice reports contained in the meteorological chart of the North Atlantic Ocean for May, issued by the Deutsche Seewarte, state that in the vicinity of the Newfoundland Bank the drift ice, consisting of bergs and field ice, had greatly increased, and up to the third week in April had advanced southwards to nearly latitude 43° N., and eastwards to 41½° W. longitude. According to a report from St. John's (Newfoundland), at the end of March such a large amount of ice is seldom seen so early in the season. On the east coast of Cape Breton Island (Nova Scotia) much difficulty was caused to navigation. The conditions near Quebec had, however, much improved.

THE fifth general meeting of the Alchemical Society was held on Friday last, May 9, at the International Club, Regent Street, S.W. The chair was occupied by the honorary president, Prof. J. Ferguson, professor of chemistry in the University of Glasgow, and a paper by the Ven. Dr. J. B. Craven, Archdeacon of Orkney, was read, entitled "A Scottish Alchemist of the Seventeenth Century: David, Lord Balcarres." The author has been permitted to examine what remains of Balcarres's library, and has found therein a MS. translation of the famous "Fama Fraternitas," antedating the earliest published translations. The paper also contained particulars of other interesting MSS. in this library, and concluded with an old Fifeshire legend showing the fantastic views which were once held concerning the Rosicrucians.

ON Tuesday next, May 20, Prof. T. B. Wood will deliver the first of a course of three lectures at the Royal Institution on recent advances in the production and utilisation of wheat in England; on Thursday, May 22, Prof. W. J. Pope will begin a course of three lectures on recent chemical advances: (1) molecular architecture, (2) chemistry in space, (3) the structure of crystals; and on Saturday, May 24, Prof. Rutherford will commence a course of three lectures on radio-activity: (1) the α rays, (2) the origin of the β and γ rays, (3) the radio-active state of the earth and atmosphere. The Friday evening discourse on May 23 will be delivered by Prof. S. P. Thompson on the secret of the permanent magnet; on May 30 by Dr. Owen Seaman on parody; and on June 6 by Dr. Francis Ward on reflection and refraction of light as concealing and revealing factors in subaquatic life.

IT is proposed to celebrate the centenary of the foundation of the Indian Museum in Calcutta next February. Originally founded as a branch of the Asiatic Society of Bengal at the suggestion of Wallich, the botanist, on February 2, 1814, the Indian Museum became a Government institution in 1867, after prolonged negotiations with the Government of India, which accepted the society's collections to form the nucleus of an imperial museum in Calcutta. A strong centenary committee has been formed with his Excellency, Lord Carmichael, the Governor of Bengal, as chairman, and Sir Asutosh Mookerjee, Vice-Chancellor of the Calcutta University, as vice-chairman. The committee has decided to publish an official history of the museum, to raise a special fund for the improvement of the public galleries, and to hold a reception in the museum on the anniversary of its foundation.

IN connection with the Panama-Pacific International Exhibition to be held in San Francisco in 1915, a

great display of horticulture is being arranged. The Horticultural Palace will provide an area of 207,000 sq. ft., and the building will be divided into three sections, namely tropical, semi-tropical, and temperate. In addition, about fifty acres will be reserved for outdoor nursery exhibits. The hall will be ready for the exhibits seven months before the opening of the exhibition, on February 20, 1915, and it is hoped that many of the plants will thus acquire the appearance of permanency before they are exposed to public inspection. In order to give extra novelty to the exhibition, the management offers a cup of the value of 1000 dollars for the best new seedling rose never previously exhibited. The rose which is awarded this prize will be named by the exhibition directors.

UNDER the title "Glorification de l'œuvre de Paul Schutzenberger," the *Revue Scientifique* of April 19 publishes a series of addresses delivered at the Ecole Municipale of Paris, on the occasion of the presentation to the city of Paris of a medallion, executed by M. Urbain, in commemoration of the life-work of the great chemist who was the organiser and first director of this famous school. Eulogies of Schutzenberger's purely scientific work were delivered by Profs. Haller, Noelting, and Matignon, whilst MM. Blondel, Lindet, and Scheurer dwelt on the very great influence he exerted on modern chemical industry by his investigations of the nature of dyes, and his discovery of hydrosulphurous acid and its application to indigo dyeing, which he effected in conjunction with M. de Lalande; the latter has within recent years led to the most important developments in the textile arts.

THE fine collection of Indian big-game heads and horns left to the nation at the close of last summer by the late Mr. A. O. Hume has been placed on exhibition as a special series on the walls of the second floor of the central hall of the Natural History Museum, above and near the statue of Sir Joseph Banks. Immediately over the statue are displayed the skulls of gaur, yak, and buffalo, while those of wild sheep occupy the wall immediately to the right, and those of ibex, wild goats, and markhor the corresponding position on the left. On the extreme right flank are displayed the blackbuck, chiru, gazelle, and nilgai heads, while on the left flank are arranged the serow, tahr, and takin. The wall to the left of the entrance to the upper mammal gallery is occupied by the magnificent series of deer antlers, while a portion of the wall facing the one behind the statue has been assigned to a few heads of African antelopes included in the collection. The exhibit adds a striking and attractive feature to the museum.

THE *Rassegna Contemporanea* (Anno vi., ser. ii., fasc. 6) contains an article on the date of the death of Christ by Pio Emanuelli. The Crucifixion took placed on the 14th day of Nisan, the first month of the Jewish year, and on a Friday. The month did not begin on the actual day of new moon, but on the evening when the thin sickle of the young moon was first perceived. The first problem to solve is therefore: How soon after the moment of new moon can the moon be seen? This has been investigated by Mr. J. K. Fotheringham, in the *Monthly Notices* for May, 1910, and by Mr. R. Courtenay, in *The Observatory* for June, 1911. The shortest possible interval after which the moon may be visible appears to be twenty-three hours, which, however, in certain circumstances may be considerably prolonged. Signor Emanuelli quotes these two papers, but does not give any particulars as to what he considers the smallest visible phase of the moon. He goes through the new moons nearest to the vernal equinox for the years A.D. 28 to 34 much in the same manner as done by Mr. Courtenay, and comes to the same result, that only A.D. 30, April 7, and A.D. 33, April 3, correspond to the 14th Nisan and also to a Friday. He decides for the year 30, as he says (without entering into explanations) that historical criticism excludes the year 33.

IN the May issue of *Man* Mr. T. A. Joyce describes a fine gold beaker from Lambayeque, Peru, now in the collection of Mr. James Curle. The technique, representing a warrior with his shield, shows considerable skill. It is beaten out of a single sheet of metal, without any trace of a join. The outline is elegant and harmonious, and the lines of the design, in spite of its conventional nature, are bold and effective. It seems to belong to the period which immediately preceded the conquest of the coast by the Inca, a period of technical progress but artistic decadence.

IN *The Scientific American* of April 19, Mr. E. J. Banks gives an interesting account of recent German excavations in Babylonia. Attention was principally directed to the mound at Babylon known as the Kasr. Babylon, after all, turns out to be a comparatively modern city as compared with those to the south. The expedition has discovered a black monolith brought in ancient times as a war trophy from the Hittite city of Karchemish. Dr. Koldewey's chief discovery is that of the palace of Nebuchadnezzar on the Kasr, of which practically only the foundations remain. At Amran, again, 40 ft. below the surface, he has found Esagil, the famous temple of Babylon. At Assur, Dr. Andrae and his successor, Dr. Maresh, have traced the city walls and several ancient palaces and temples. Excavation is now in progress at Erech or Warka, the home of the hero of the Gilgamish epic. Here discoveries of the greatest scientific interest may be expected.

AN illustrated report (Research Bulletin 28) has been issued by the University of Wisconsin Agricultural Experiment Station on avian tuberculosis, the authors being Messrs. Hastings and Halpin. While not very frequent, the disease is of some economic importance. The authors were able to infect guinea-pigs, hogs, and rabbits with the avian, but were unable to infect hens with the human, tubercle bacillus. Suggestions are made for the elimination of the disease from the flocks.

IN the Journal of the Washington Academy of Sciences for March 19 (vol. iii., No. 6), Messrs. Ayers and Johnson detail experiments on the destruction of bacteria in milk by the ultra-violet rays generated by a quartz mercury-vapour lamp. When the

milk was exposed in thin layers to the rays, a marked reduction in the bacterial content was obtained, but the experiments indicate that it would not be possible to sterilise milk completely by the ultra-violet rays. In some cases an abnormal disagreeable flavour was produced by the rays.

THE Alpine Club of Canada has set a good example to kindred bodies by publishing in *The Canadian Alpine Journal*, 1912, lists of the mammals (by Mr. N. Hollister), birds (by Mr. J. H. Riley), and plants (by Mr. P. C. Standley) of the Mount Robson district, Mr. Hollister also giving a note on the reptiles and amphibians.

WE have received the first five numbers of a new journal (or work), entitled *Java, Zoologisch en Biologisch*, by Dr. J. C. Konigsberger, published at Buitenzorg, the first number being dated 1911, and the other four 1912. Its object is apparently to give a general popular account of the leading features of the meteorology and fauna of the island, the fauna being divided into a coastal fauna, the fauna of the plains, and the fauna of the high mountains.

A RESTORATION and model of the skeleton of the gigantic carnivorous dinosaur Tyrannosaurus, from the Montana Cretaceous, form the subject of an article by Prof. H. F. Osborn in the Bull. Amer. Mus. Nat. Hist., vol. xxxii., pp. 91–92. Another paper on reptilian palæontology is to be found in the Annals of the Transvaal Museum, vol. iv., pp. 1–46, where Dr. E. C. N. van Hoepen describes and figures in great detail a remarkably fine skull of the Karroo dicynodont *Lystrosaurus* (*olim Ptychognathus*) *latirostris*.

THE *Aarsberetning* for 1912 indicates that the naturalists of the Bergen Museum have been engaged in arranging exhibition series to illustrate the osteology of vertebrates in somewhat the same fashion as those displayed in the hall of our own Natural History Museum, photographs of the new exhibits being included in the report. The work of the biological station has also been conducted with the usual energy; pictures and plans of a new vessel and a map of the hydrographical stations in the neighbourhood of Bergen accompany the report.

WE have received from the Government of India copies of three Forest Bulletins (Nos. 13–15), by Mr. R. S. Pearson, dealing respectively with "ligno" as a means of protecting timber from splitting while seasoning, with the strength of natural and plantation-grown teak, and with the technical properties of toon wood (*Cedrela toona*), and giving evidence of the enterprise and activity of the Imperial Forest Service officers at the Dehra Dun Institute of Forest Research. In No. 13, the author describes briefly the methods employed for seasoning timber, and some experiments made with "ligno"—a light-brown plastic substance of the consistency of thick paint which has been placed on the market recently. The application of this protective substance is based on the principle of retarding evaporation from cut ends of logs and thus preventing splitting; the result of the severe tests applied was that "ligno" was found to be very effective in retarding the seasoning process, though not absolutely preventing splitting. In No. 14 details are given showing that plantation-grown teak is as strong as that from natural forests; the figures for compression and shearing tests show that the percentage of moisture in the timber has no marked effect on the strength of teak, whereas it has a considerable effect when transverse strain is applied across the fibre. In No. 15 details are given showing that toon timber, after contracting considerably during seasoning, is very liable to absorb moisture and expand again when seasoned, this process of contraction and expansion continuing for several years, though becoming less marked in successive years; hence in order to prevent this excellent furniture timber from falling into disrepute it is only necessary to allow a longer time for seasoning.

THE Meteorological Chart of the North Pacific Ocean for May, published by the U.S. Weather Bureau, contains the concluding part of several articles on cyclonic storms and typhoons of that ocean by Mr. W. E. Hurd. They constitute a very useful summary of the subject, compiled from available sources, including quotations from Father Algué's valuable report on the cyclones of the Far East, and track charts for various months. It is pointed out in the Barometer Manual issued by the Meteorological Committee that the tracks of tropical storms of the North Pacific are very similar to those of the North Atlantic. "Typhoons of the China Sea originate to the eastward of the Philippines, Carolines, and Ladrones. In the lower latitudes the centres travel westward. Some pass over the mainland, some recurve to the eastward, and eventually reach the west coast of North America by way of Japan." Near the Philippines the rate of translation is from six to twelve miles an hour, but in the vicinity of Japan the speed is greatly increased. Since the establishment of telegraphic communication between the Philippines and the outlying islands the warning of approaching storms is very efficient. The "barocyclonometer," invented at the Manila Observatory, "for ascertaining the position, distance, and direction of advance of a cyclone," is both ingenious and important; it is said to be in general use among East Indian vessels.

A PAMPHLET of "Suggestions for Investigations in Human Geography in Britain" has been written by Dr. H. J. Fleure and Mr. W. E. Whitehouse, and is issued from the registrar's office in the University College of Wales, Aberystwyth. It claims for "human geography, the part of the subject which deals with man's relation to his physical environment," the status of "the main objective of geographical study." The authors' ideals of detailed local investigation on these lines are lofty and exhaustive: a list of no fewer than eighty suggested "sections for investigation" is laid down, and many of them, such as those involving philological and antiquarian research, would demand a special training, quite outside that afforded by geography alone, for the investigator. No doubt, however, in

such departments as these it is the authors' desire to impress the geographical point of view upon the specialists in other departments of knowledge. The geographical application of the authors' suggestions is not always clear · some of the details instanced in connection with fairs may serve as examples—and again, the geographer who attempts to take up such a topic as the "prehuman" condition of a given district is certainly liable to disappointment at the results obtainable. On these counts the impression may be felt that the writers of this pamphlet have spread their net too widely. They appear (and they are not alone) to forget their own definition of human geography, which has been quoted above. But if this be a fault it is far better than that of taking too narrow a view, and the pamphlet, criticism apart, must be regarded as profoundly suggestive, and as having been worked out with very great care.

A PARTY of students, under the direction of Prof. K. Honda, made some interesting simultaneous observations at different stations during August, 1912, on the seiches of Lake Inawasiro (Japan). The lake, which is near the well-known volcano Bandai, is about 12 km. long and 10 km. wide, and has a mean depth of $51\frac{1}{2}$ metres. The limnimeters show that there were two oscillations of considerable amplitude with mean periods of 19·11 mins. and 8·89 mins., corresponding to the uninodal and binodal oscillations of the lake. A model of the lake was constructed, and the water in it was made to oscillate by means of a vibrating rod. The periods of the oscillations in the model correspond to periods of 19·53 and 9·11 minutes in the actual lake, while the forms of the nodal lines were clearly shown by means of aluminium powder with which the surface of the water was dusted.

A USEFUL method of calculating the mean variation by the aid of a calculating machine is given by Prof. Knight Dunlap in the current number of *The Psychological Review*. If in a given series of N terms, with average M, P terms be greater and R terms be less than the average, then the mean variation may be calculated from either of the two formulæ,

$$\frac{\Sigma P - P.N}{\frac{N}{2}} \quad \text{or} \quad \frac{R.M - \Sigma R}{N}$$

"By the use of the calculating machine, great accuracy may be obtained with the minimal expenditure of time and energy," if such methods as the above are followed, which dispense with the numerous subtractions of the older method.

FROM the report of the joint committee appointed by the Institution of Electrical Engineers, the Institution of Gas Engineers, the Institution of Municipal and County Engineers, and the Illuminating Engineering Society, on street lighting, with which Mr. Trotter opened the discussion of the subject at the last meeting of the Illuminating Engineers, and from the reports of the discussion which have appeared in the technical Press, it seems possible that the measurement of the minimum illumination of a plane 39 in. above the ground will eventually be accepted as the criterion of good or bad lighting of a street. The classification proposed by the committee is as follows:—Class A, minimum 0·01; B, 0·025, C, 0·04; D, 0·6; E, 0·10 foot-candle.

WHEN a curve is drawn in the ordinary way to represent the effect of light upon a photographic plate, the part of it that represents the effect of the shortest exposures is exceptional in that it shows gradation that is less steep than the part that follows it, and gradually approximates to it. This exceptional part was called by Messrs. Hurter and Driffield the "period of under-exposure," and plate-makers were advised to reduce it as much as possible, and photographers to avoid it. But this "period" cannot be eliminated, and therefore in practical work it remains, as it always has been, of very great importance, although Messrs. Hurter and Driffield dismissed it with but little consideration. After an interval of more than twenty years, Mr. F. F. Renwick, of Ilford, Ltd., has taken up the study of this particular period, and in the April number of the Journal of the Royal Photographic Society there is published a paper upon it that he recently communicated to the society. Mr. Renwick finds that the "under-exposure period" is not so disadvantageous as some theoreticians have endeavoured to prove it to be, and to a certain extent he justifies the practical workers who utilise it to the utmost. He shows the nature of this part of the density curve in many various plates and printing papers, giving full details, and points out that as the curve in printing papers is of the same general character as that in the negative, the gradation error of the latter is, more or less, compensated in printing.

To the *Revue générale des Sciences* of March 30 M. Ch. Maurain contributes an article on "Les Etudes d'Aérotechnique à l'Institut de St. Cyr." The recently founded aëronautical laboratory at St. Cyr differs fundamentally in its methods from that of almost all other existing institutions for aëronautical research, and its apparatus is designed for the purpose of "approaching as closely as possible to the practical conditions of aërial locomotion." By this is meant scientific experimental research on full-scale model at full speeds, and some work of a preliminary character on wing surfaces has already been accomplished. The work is being extended to experiments on large propellers, and provision is being made for the construction of a measuring apparatus sufficiently strong to be able to carry a complete aëroplane. The apparatus is mostly out in the open, and consists essentially of a track more than three-quarters of a mile in length, along which electrically-driven carriages can be run at speeds up to fifty miles per hour. The measuring apparatus is attached to the carriage, and during the eight or ten seconds in which the speed is maintained constant the forces and couples on the model under test are automatically recorded. Concurrently with these experiments, measurements are being obtained on aëroplanes in flight, and on small models held in a current of air. The latter experiments on small-scale models are expected to give information as to the conversion factors for scale which may become important as the science of aviation develops.

RED Book No. 173 of the British Fire Prevention Committee contains an account, with photographs, of tests on reinforced concrete doors. These doors were constructed to the designs of Commandant Welsch, ex-chief officer of the Ghent Fire Brigade. No. 1 door had a T iron rim and expanded metal and flat-iron reinforcement filled in with concrete; this door was hung on runners and made to slide, and was fixed on the outside of an opening. No. 2 door was similar to No. 1 door, but fixed on the inside of an opening. In No. 3 test two doors as described above were used, one on the inside and one on the outside of an opening. In No. 3 test, the doors were subjected to the action of a fire of 150 minutes' duration at temperatures gradually increasing to about 2000° F., followed by the application of water for two minutes on the fire side. In thirty-two minutes the outer face of the outer door was too hot to bear the hand, and in 140 minutes the lower half of the door had bulged outwards. In seventeen minutes cracks appeared all over the fire side of the inner door and continued to increase; in 107 minutes this door came away from the runner at one top corner; in 150 minutes the door fell forwards into the interior of the hut. On water being applied, the inner face of the outer door was eroded where struck by the jet. The tests afford some very useful lessons and give information which should lead to the design of an efficient fireproof reinforced concrete door.

THE report of the council and the proceedings of the Hampstead Scientific Society for the year 1912 show that the work of the society, which was founded in 1899, not only expanded greatly during the year, but increased in value. It is hoped that during the present month the work "Hampstead Heath: its Geology and Natural History," prepared by members of the society, will be published. The Mayor and Borough Council of Hampstead have invited the South-Eastern Union of Scientific Societies to hold its annual congress at Hampstead this summer, and the meetings will be held from June 4 to 7. Thirty-two meetings were held during the year, besides six summer outdoor meetings and a course of four lectures to juveniles during the Christmas holidays. Among the list of lecturers during the year we notice the names of the president of the society, Prof. W. M. Flinders Petrie, and of Profs. A. Fowler and A. W. Porter. The report records a deficit on the general working of the society, due to the heavy expenditure involved in the maintenance of the meteorological station, which has now three years of unbroken meteorological records to its credit.

AMONG the most recent additions to the admirable series of "The People's Books," which Messrs. T. C. and E. C. Jack are publishing at *6d.* net each, are three volumes dealing with subjects of science and technology. Dr. P. Phillips writes on the "Science of Light," and intends his book to be a companion to that on "Radiation," already published in the series. In between eighty and ninety small pages he deals with the propagation, reflection, refraction, dispersion, interference, and polarisation of light, and also explains diffraction and the electromagnetic nature of light waves. The treatment is necessarily slight, but the volume will prove useful even to students of physics, because of the outline history of the science which it contains. In a volume on "British Birds," Mr. F. B. Kirkman gives descriptions of 187 of the commoner species and their nests and eggs. Mr. A. W. Seaby has provided 111 illustrations, which, though small, give a good idea of the birds described. The third book is on "Gardening," and is by Mr. A. C. Bartlett, who has confined his attention to descriptions of the chief gardening operations and the propagation of plants by cuttings, grafting, budding, and other methods.

OUR ASTRONOMICAL COLUMN.

A NEW FAINT COMET (1913*a*).—A Kiel telegram of date May 7 reports the discovery of a comet of magnitude 9·5 on May 6, at 15h. 5m. mean time, Nice, by M. Schaumasse, of the Nice Observatory. Its position when discovered was given as R.A. 20h. 54m. 44s., and declination +9° 52′, and it was moving in a north-easterly direction.

A Kiel circular of May 10 gives the following elements and ephemeris, computed by Kiess and Nicholson

$$
\begin{aligned}
T &= \text{May } 17\cdot91 \text{ G.M.T.} \\
\omega &= 57^\circ\ 28' \\
\Omega &= 317^\circ\ 0' \\
i &= 26^\circ\ 26' \\
q &= 1\cdot440
\end{aligned}
$$

		h. m. s.	° ′
May 15	...	20 16 12	... +19 0
,, 19	...	19 48 37	... +24 13
,, 23	...	19 11 22	... +30 7

The comet rises this evening about 9.20, and should be capable of being seen with telescopes of moderate power in the early morning hours.

THE PHYSICAL APPEARANCE OF MARS.—It is well known that observers of the planet Mars are divided into two schools, one believing that the so-called canals are really long, continuous, and narrow streaks, the other looking upon them as the summation of a complexity of detail revealing irregular streaks and presenting frequent interruptions and condensations. In the current number of *Knowledge*, Mr. Antoniadi, a strong advocate of the latter view, communicates an interesting article on the subject of these Martian markings, and puts forward his explanation of the divergency of ideas of observers of their appearance. Large *versus* small aperture is his main reason; thus he writes:—"The student who passes many consecutive hours in the study of Mars with medium-sized instruments is liable to catch rare glimpses of straight lines, single or double, generally lasting about one-quarter of a second. Here we have a vindication of Schiaparelli's discoveries. But their deceitful character will obtrude itself on the observer using a large telescope, when, in the place of lines, he will behold steadily either a winding, knotted, irregular band, or the jagged edge of a half-tone, or some other complex detail." The article is illustrated by a fine set of drawings of the planet made in 1911, the observations being made with the 33-in. refractor of the Meudon Observatory.

THE NATIONAL OBSERVATORY OF ATHENS.—Vol. vi. of the *Annales de l'Observatoire National d'Athènes* contains a series of valuable contributions published under the direction of Prof. Demetrius Eginitis, the director of the observatory. It is only possible here to state the titles of the memoirs and sets of observa-

tions, as the volume covers more than 300 pages, and is illustrated with numerous plates. The memoirs deal with Halley's comet during its last return; observations of the major planets; Nova Lacertæ; the earthquake in the Gulf of Corinth on May 30, 1909; and, finally, with the study of seismic disturbances in Greece during the years 1909–11. The second portion of the volume deals with observations for the same period, and these include equatorial and meridional observations, meteorological observations made at the observatory and at departmental stations, and, lastly, a catalogue of earthquakes observed in Greece during the same year.

FREQUENCY OF PROMINENCES ON EASTERN AND WESTERN LIMBS OF THE SUN.—Mr. Evershed has examined statistically a mass of very complete material of prominence observations, both visual and photographic, to inquire into the question as to whether one limb is more prolific than the other (Kodaikanal Observatory Bulletin No. 28). In his examination he has gone thoroughly into the question of the methods of observation for both kinds of records in order to make certain that the results were in no way affected by any kind of systematic bias in favour of one limb over the other.

The result of the inquiry is that there is a distinct predominance of frequency at the eastern limb. Briefly summarised, the different records led him to the following conclusions. The Kodaikanal observations for 1904–11 displayed as regards numbers for each year a nearly constant excess of east over west, the average percentage of east being 52·70. The Kenley and Catania series for 1894–1905 exhibited also an eastern excess averaging 50·8 per cent of the whole number recorded; for the period 1906–11 the Catania observations displayed an eastern excess of 54·26 per cent. At Kodaikanal during 1905–11 the larger prominences showed a smaller eastern excess than the smaller prominences, the percentages being 51·16 and 53·60 respectively. In the case of profile areas of prominences a small average excess of eastern areas is observed. The eastern excess as regards numbers is about the same for prominences in equatorial regions up to 30·5° lat. as for those in higher latitudes.

Mr. Evershed directs attention to a slight evidence of planetary action similar in effect to that of the earth in the case of Venus only among the major planets, and also to an annual periodicity in the eastern predominance with maxima in January and August and minima in April and November. In a supplementary note he points out that metallic prominences and those showing displacements of the hydrogen lines show a much greater preponderance of east over west, the percentages in these cases being 59·9 and 57 respectively. As all the observations were made visually there is the possibility of bias in favour of the eastern limb.

EVENING EDUCATIONAL WORK IN LONDON.[1]

A VERY valuable and interesting survey of the progress of technical, scientific, and commercial education in evening classes in the London polytechnics, technical institutes, and continuation schools has recently been presented to the Education Committee of the London County Council by Mr. R. Blair, the education officer of the council.

The provision now made of instruction in evening classes in London is of remarkable range and extent. It comprises tuition, at almost nominal fees, in all stages of science, technology, arts and crafts, commercial subjects, economics, and literature, in well-equipped institutions from qualified teachers. The London evening student has now far greater educational facilities open to him than are offered in even the most progressive provincial towns, especially in the matter of securing university recognition for his work, if of a sufficiently high standard.

Some idea of the magnitude, the complexity and the importance of the educational work carried on in evening classes in London is given in the following numbers taken from the report:—

The approximate number of evening students enrolled in 1910–11 was as follows (p.

(1) In the polytechnics	25,000
(2) In technical institutes and schools of art maintained by the L.C.C.	10,000
(3) In commercial centres	30,000
(4) In ordinary evening schools	100,000
(5) In other institutions, settlements, &c. (estimated)	30,000
	195,000

Deducting one-third of this number as "ineffective" students through irregular attendance, &c., it is clear that a large amount of intellectual and educational work is being steadily carried on, which must of necessity play an important part in the economic and social development of the people of London.

A curious fact is the increasing proportion of adult students, *i.e.* above twenty-one years of age, in attendance at evening classes. In 1910–11 the probable number of such students was 80,000, "more than twice the number of pupils of all kinds in all the public secondary schools of London."

The gross annual cost of maintenance of evening teaching in London may be approximately estimated at 400,000*l.*, of which about one-half is expended by the polytechnics and the technical schools.

Illustrations are given on p. 12 of the report of the direct value of the work of London technical institutions to the local industries, especially the Leathersellers' College at Bermondsey in its relation to tanning, the Northampton Institute at Clerkenwell to the optical industries, and the L.C.C. School of Photo-engraving and Lithography with respect to the "three-colour" process. In addition to their industrial and technical work, a considerable amount of purely scientific research emanates from the London polytechnics each year, an excellent account of this branch of their activities being given in pages 42 to 47 of the report.

In a memorandum by Mr. A. E. Briscoe (divisional inspector) upon the "Polytechnics and Technical Institutes," it is stated:—"A good deal of very uninformed criticism is directed against instruction in evening classes; it is often urged that such work cannot be effective; that attendance must be irregular; that students are frequently too tired physically and mentally to make the best use of the time available, and that they are also ill-prepared by their previous education. There is some truth in these contentions, but those who urge them . . . their views would be materially altered if they would but spend a week in a close inspection of the work that is actually done. . . . The first thing that would strike them would be the eagerness to learn. . . . The evening student has less time for study, but he makes more effective use of it. He has practical knowledge that forms an excellent basis. . . . In many institutions evening students are doing work in their subjects quite equal to that required for a university degree."

[1] Report on Eight Years of Technical Education and Continuation Schools (mostly evening work). Presented to the Education Committee on December 11, 1912, and ordered to be printed. London County Council Education Committee: P. S. King & Sons. Price 2*s.* 6*d.*

In finally summarising the position of evening education in London, Mr. Blair concludes with the following passage (p. 24):—"A large increase of students in higher institutions, a large extension of premises and improved equipment, a large increase all over in attendance hours per student . . . an increased representation of masters and workmen on advisory committees, with a corresponding increase in the interest of employers, and of expert criticism of work done, all support the view that the period 1904–12 has been characterised by great expansion in quantity and quality of work."

Since the publication of the report referred to above the education committee of the council has decided upon a comprehensive scheme of reorganisation of the evening continuation schools, which are in future to be termed "institutes" instead of "schools." The main features of the scheme are the specialisation of the functions of individual schools depending upon the social, educational, and industrial demands of the respective districts, the appointment of a number of "responsible masters" for evening work only, the increased provision of non-vocational education, and definite coordination with higher institutions, such as the polytechnics. It is mainly in respect to the last point that the organisation of London evening education has compared very unfavourably of recent years with the organisation in a number of provincial towns.

The junior technical institutes will be definitely linked up in future with the neighbouring polytechnic. The principal (or head of department) of the higher institution will have the right to visit the junior institute in an advisory capacity, and to offer advice upon the appointment of the staff and upon the framing of courses and syllabuses. Standing local committees will be formed consisting of the principal and heads of departments of the polytechnic and "responsible masters" of the junior institutes, in order to cement the relationship between the two types of institutions.

The new scheme as a whole is thoroughly sound, and, if carried out, as there is every reason to expect will be the case, it will undoubtedly have far-reaching, beneficial effects upon London education.

J. WILSON.

LAW OF THE PAY-STREAK IN PLACER DEPOSITS.[1]

EXPLANATIONS of the eccentricities of the pay-streak in placer deposits have long been considered difficult to furnish. Geikie, Beck, Posepny, Locke, Lindgren, and many others have all discussed the subject and acknowledged the fact. Eight years' residence and study of placer phenomena in the Klondike gold-bearing region of Canada on the part of Mr. J. B. Tyrrell have enabled him to formulate a natural law respecting the location of the pay-streak, not only in the Klondike, but also in any placer region of the world.

An accurate knowledge of the structure and growth of a valley, comprising the different phases of its history in detail, always presents geological facts and deductions capable of broad and general application, and these are generally recognisable without great difficulty. After considering the nature and rate of erosion and sedimentation in a given valley under normal stream action, the formation of a V-shaped valley and its transformation into a U-shaped one, and the presence of flood-plains and terraces, the laws governing the formation and position of the pay-streak in an alluvial plain in the bottom of a valley may be stated as follows:—

(1) It was formed in the bottom and at the mouth of the V-shaped valley which was the young representative of the present valley.

(2) It marks the position formerly occupied by the bottom of that V-shaped valley.

(3) The gold contained in it was washed out of the surrounding country and collected into approximately its present position before the gravel of the flood-plain (or terrace) was deposited over and around it.

The practical application of this discovery of identifying nature's way of hydraulicing and storing the gold in the bottoms of the valleys must be welcome to all economic geologists and mining engineers.

Mr. Tyrrell holds that some 30,000,000*l.* of gold has been recovered to date from the Klondike region, and that an equal amount no doubt remains to be extracted. Some 900 ft. thick of rock-formations have been removed from the Klondike country, and 130 cubic miles of gravel scattered over the 800 square miles of placer deposits, making only one-hundredth of a pennyworth of gold per ton of original rock concentrated by nature.

H. M. A.

[1] "The Laws of the Pay-streak in Placer Deposits." By J. B. Tyrrell. Trans. Inst. Min. and Metal'urgy, pp. 593–605. (London, 1912.)

THE UPPER AIR DURING FÖHN.

DR. H. VON FICKER has made notable additions to our knowledge of Föhn by his contributions on this subject to the Transactions of the Vienna Academy. His researches showed that the Alpine Föhn is the local manifestation of an extensive phenomenon which is revealed almost simultaneously in places of the same altitude over a large region. In a paper in the *Sitzungsberichte* of the Vienna Academy, May, 1912, he describes observations on Föhn during three balloon ascents from Innsbruck in 1910 and 1911. It was found impossible to make ascents at the time of actual Föhn at the surface owing to the very gusty character of this wind. In one ascent only was the balloon over the mountains at the time of Föhn, and then it was the plaything of the vertical currents, which, however, were kind enough to spare the balloonists actual disaster. At one time the balloon was carried downwards 900 m. and up again 1100 m. in the course of five minutes, indicating vertical currents of five metres per second or more. Such information is clearly of importance to aviators, apart from its bearing on the elucidation of the meteorological phenomenon.

The general conclusions of von Ficker are that before the outbreak of Föhn at the surface, it is blowing over the cold air in the valleys and plains, the surface of separation between the two currents being frequently marked by strato-cumulus cloud. When the Föhn current crosses the ridges and valleys at right angles it descends on the lee side and ascends on the windward side, with a partial clearing of the cloud in the region of descending air. Föhn is usually dissipated by the coming of a north-west wind, the change probably being of the nature of a line-squall. The vertical temperature gradient during Föhn was usually less than the adiabatic gradient for dry air, except when the balloon was carried up and down in the vertical currents, but it was greater than the normal gradient. The change of wind direction with altitude was normal, the south-east wind of the lower layers changing to south and south-west winds at higher levels up to 3–4 km. The value of the discussion is enhanced by the results of ascents at Munich and observations at Zugspitze (3000 m.) which the author was able to incorporate by the courtesy of Dr. Schmauss, who is keenly enthusiastic about all upper-air investigation.

E. GOLD.

ACTIVE NITROGEN.[1]

EVERYONE has heard of ozone, the active modification of oxygen which is produced when this gas is subjected to electric discharge. I hope to

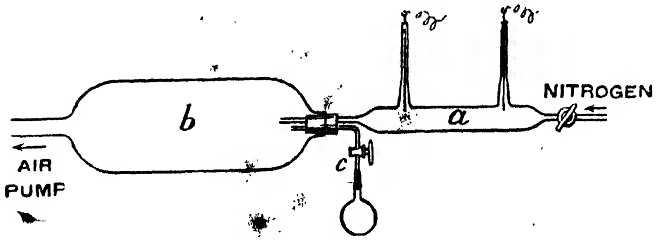


FIG. 1.

show you to-night that nitrogen can also be made to assume an active state under suitable experimental conditions. We will begin with an experiment (Fig. 1) which will serve to introduce the subject.

A rapid stream of rarefied nitrogen gas passes through the tube *a* at a pressure of a few mm. of mercury, and on its way the gas is sparked through by a series of high-tension electric discharges from a Leyden jar. It then issues as a jet into the large vessel *b*, where it is seen to be brilliantly luminous, the stream of gas being visible as a whirling cloud of brilliant yellow light. Notice that this light is of a different colour from that of the electric discharge in the former vessel.

Why does the gas remain luminous in this way for an appreciable time after the electric discharge has passed through it? The view which I shall develop this evening is that the discharge has split the nitrogen molecules into single atoms. Nitrogen atoms in this condition are uneasy, and are anxious to find partners again. But to do this takes time. The reunion of the nitrogen atoms is attended with the emission of the yellow light which you see, and this continues so long as the process of pairing off is incomplete.

Preliminary even to considering this theory, we must be certain that nothing but nitrogen is necessary to the success of the experiment, and that no other substance intervenes. Some experimenters in Germany have recently expressed the opinion that traces of oxygen are concerned. I am satisfied, however, that they are entirely mistaken. The nitrogen used in the experiment you have just seen has been standing in contact with phosphorus until the phosphorus no longer glows in the dark. If I added a 1/100,000th part of oxygen to the nitrogen, the phosphorus would begin glowing again quite perceptibly. So we may be sure that there is not that amount of oxygen present: and I do not think it is reasonable to attribute these brilliant effects to a smaller amount. Again, we may inquire what is the effect of adding oxygen intentionally? I find that the addition of 2 per cent. of oxygen is enough to obliterate the phenomena altogether. Much more might be said on the subject, but we must pass on.

It is convenient for some purposes to experiment in a different way. We have here two similar glass globes containing rarefied nitrogen. I can induce an electric discharge in them without electrodes by putting them in this coil of wire, through which a Leyden jar is constantly discharging. When I withdraw them you see that they are brilliantly luminous, and that they remain so for several minutes after stimulation. By holding them alternately in the exciting coil we can get them about equally bright, and you see that the luminosity of each decays at about the same rate. Now I stimulate them equally again, and cool one down by immersing it in liquid air. It shines brightly for a moment, but soon becomes quenched. I withdraw it, and you can compare it with the other, which is still brightly luminous.

This experiment shows that cooling the gas shortens the period of luminosity. Let me show you next that the brilliance is increased by cooling. I have exhausted this bulb to a suitable degree, and cool the neck by immersion in liquid air, contained in a transparent vessel (Fig. 2). You see how much brighter the cooled portion is after excitation than the rest of the bulb. There is no doubt a certain ambiguity in this form of experiment, because cooling a portion of the vessel causes a local concentration of the gas in that portion. I must ask you to take it from me that special experiments have proved that this cause is not enough to explain the greatly increased brightness you have seen. The reunion of nitrogen atoms occurs, then, more quickly the lower the temperature. This is a unique instance of a chemical action being quickened by cooling. In all other cases heating accelerates the action. Plausible objections may be made to this statement, but I must content myself now with saying that they admit of answer.

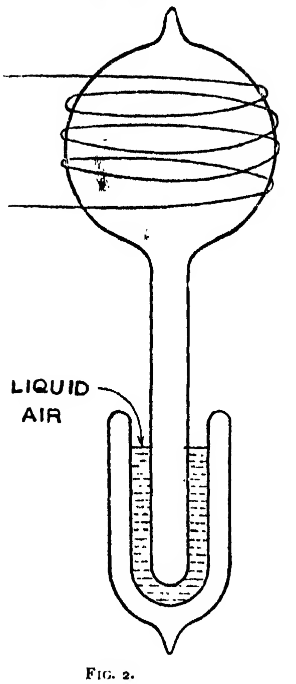
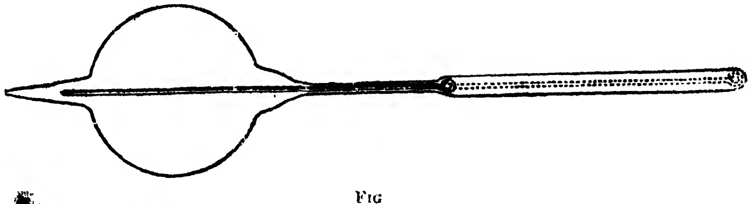


FIG. 2.

When oxygen and hydrogen unite, the union may occur in two distinct ways. It may occur with luminosity throughout the volume of the mixture, as when the gases are exploded, or, again, it may occur at the surface of a solid such as clean platinum. In the latter case there is no luminosity.



FIG

Similarly, active nitrogen atoms may reunite in the volume of the gas with luminosity—this we have seen already—or the combination may occur without luminosity at a suitable surface. Oxidised copper

[1] Discourse delivered at the Royal Institution on Friday, February 28, by the Hon. R. J. Strutt, F.R.S.

affords such a surface. This bulb (Fig. 3) can be made to glow like those you have seen before, by inserting it into a coil; and if the copper wire is situated in the side tube the glow lasts a long time, for the gas has as yet no access to it. But if I excite the gas again, and turn the bulb round so as to drop the oxidised wire into it, you see that the luminosity is extinguished in a fraction of a second. Combination of the nitrogen atoms occurs much more quickly at the surface, so that the whole quantity of active nitrogen present is almost instantly used up. Incidentally, the experiment illustrates the extremely rapid diffusion of the gaseous residuum in an exhausted vessel, for every particle of the active nitrogen must evidently find its way to the surface of the wire in the fraction of a second.

We pass now to consider the effect of nitrogen in this condition on other substances. The yellow glow we have studied so far is due to the recombination of nitrogen atoms, and accordingly it shows a nitrogen spectrum, though with very curious modifications.

If we offer to the monatomic nitrogen other substances, it will often unite chemically with them, which, of course, cold ordinary nitrogen will not do. I go back to the apparatus used in the first experiment, and admit some acetylene by a stopcock (*c*, Fig. 1). The jet of active nitrogen now enters an atmosphere of acetylene, and you see that the character of the light is at once changed; it has become lilac. I turn off the acetylene and substitute chloroform vapour. We now get an orange light. This may appear very different, but the difference is unessential. The spectrum is in each case that characteristic of cyanogen and its compounds, only the violet portion of this spectrum is more intense with acetylene, the red portion with chloroform.

Since we get the cyanogen spectrum without having any cyanogen compound originally present, we may suspect that some such compound has been formed. Let us pass from suspicion to proof. Using chloroform vapour from a bulb containing the liquid (see Fig. 1), we pass the gases through a vessel in which a test-tube is inserted. This test-tube contains liquid air, and any condensable constituent is frozen out on to its external surface (Fig. 4). After a few minutes' run, we take out the test-tube and dip it in a solution of potash. I now add a mixture of ferrous and ferric salts and excess of hydrochloric acid. I pour out the liquid on to this white porcelain dish, and you see that abundance of prussian blue has been formed. This proves the presence of some cyanogen compound.

We can get the same result with pentane, ether, benzene, or almost any other organic vapour. With these the amount of cyanogen formed is much the same, but the cyanogen spectrum, curiously enough, is far less conspicuous. Benzene, for instance, almost quenches the nitrogen glow, and little can be seen of the cyanogen spectrum either. In most cases it appears that hydrocyanic acid is formed, but the orange cyanogen glow, only obtained in compounds containing much chlorine, is probably due to the formation of chloride of cyanogen in addition. This, when absorbed in potash, forms a cyanate, which has been detected chemically.

In the case just considered, the spectrum observed, when active nitrogen is mixed with another substance, is that of the product of the action. In some cases, however, the spectrum developed is that of the substance originally introduced. I admit some of the vapour of perchloride of tin: you see the brilliant blue glow. I introduce a drop of the liquid chloride on a wire loop into the flame of a Bunsen burner, and you see the same blue colour, though less advantageously. The brilliance of the luminous effect does not seem to give any trustworthy indication as to whether much chemical action is going on. If, for instance, we admit bisulphide of carbon vapour to the active nitrogen stream, we do not get very brilliant effects of luminosity—nothing striking enough to be worth showing you—but none the less interesting chemical actions are going on. The tube in which the action occurs gets covered with the dark blue transparent deposit, which I show by projection on the screen. This substance is a known compound of nitrogen and sulphur, originally investigated by Mr. Burt in 1910. If the gases are condensed farther on in the tube by liquid air, we get a second deposit of brown colour, which can be identified as the brown polymeric carbon monosulphide studied by Sir James Dewar and the late Dr. H. O. Jones. You see, then, that the chemical action is completely traced. Active nitrogen takes part of the sulphur from carbon disulphide, leaving carbon monosulphide.

The behaviour of active nitrogen with metallic vapours is of interest, though it has not yet been very

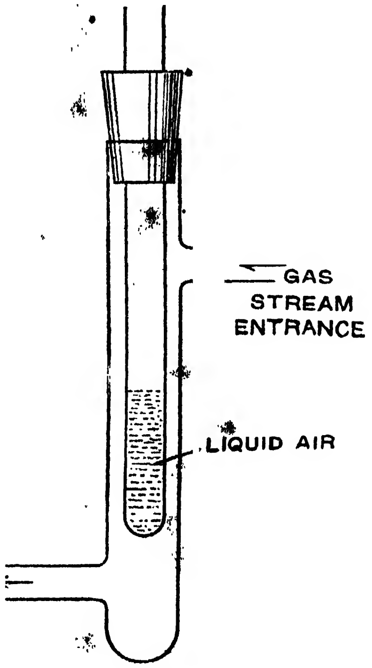


FIG. 4.

completely studied. I select the case of mercury to show you. We pass the stream of glowing gas through this tube, which contains a small pool of mercury. While the mercury is cold, the yellow glow passes on unaffected. I apply heat, and green mercury light, of the colour familiar in the mercury-vapour lamps used in electric lighting, is apparent, when active nitrogen mingles with mercury vapour. Soon the tube gets obscured, except when I am actually heating it, by a dirty-looking solid deposit containing much metallic mercury.

I wish to convince you that an explosive compound of nitrogen and mercury has been formed. For this purpose, to save the trouble of dismounting the tube already used, we will take a similar one prepared beforehand. I heat the mercurial deposit moderately over a Bunsen burner, and, if you will kindly be quite still for a moment, we shall hear a distinct crackling sound, as the explosive compound decomposes. At close quarters it is easy to see flashes of light accompanying the minute explosions, but these can scarcely

be shown to an audience, as the opaque deposit over the greater part of the tube obscures them.

It has only been possible this evening to bring forward a selection of the results of two years' work on this subject at the Imperial College, with generous help from colleagues, and facilities provided by the governors.

Let me conclude by reading to you a prophetic passage from one of Faraday's letters to Schönbein:—"What of nitrogen? Is not its apparent quiet simplicity of action all a sham? Not a sham, indeed, but still not the only state in which it can exist. If the compounds which a body can form, show something of the state and powers it may have when isolated, then what should nitrogen be in its separate state? You see I do not work; I cannot. But I fancy, and stuff my letters with such fancies (not a fit return) to you."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A NEW chair of bacteriology is to be founded in Edinburgh University under a bequest from Mr. Robert Irvine, of Royston, Granton. At his death, eleven years ago, Mr. Irvine bequeathed 230 shares of 10*l*. each in a company for developing the resources of Christmas Island for the purpose of establishing the chair when the interest from the shares should reach 25,000*l*. or 30,000*l*. The accumulated dividends on these shares now reach more than 30,000*l*. It is understood that 25,000*l*. will go towards the maintenance of the professorship, and that the remaining 5000*l*. will be used in providing the class-rooms, laboratories, and the necessary equipment.

ATTENTION has already been directed to the progress which has been made in the provision of well-equipped laboratories for the study of electrical technology and kindred subjects in the University of Hong Kong. Prof. C. A. Middleton Smith has sent us an exhaustive list of engineering and other equipment which has been presented to the University by public-spirited manufacturing firms. Their generous support of the cause of higher technical education in the distant parts of the Empire is sure to be productive of excellent results, and is worthy of emulation by other firms. The greatest support seems to have been received for the department of heat engines, and the authorities in Hong Kong hope that more offers of apparatus will be received from firms interested in electrical engineering. A complete equipment is required for experiments in all branches of electrical work, and an appeal is made to manufacturers that this branch of engineering shall be represented worthily in the equipment presented to the University. It is impossible here to mention each of the gifts which have been made, but as indicative of the substantial character of the gifts, the complete spectrographic outfit presented by Messrs. Adam Hilger and Co., and the Sankey's hand-bending testing machine given by Mr. Casella, may be mentioned.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, April 25.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—W. R. **Bower**: A graphical method of optical imagery. The paper contains a development of optical imagery based on elementary geometry, including limiting positions, but excluding cross-ratios, centres of perspective, &c. The method adopted is useful for teaching the properties of optical systems to those who are not essentially students of pure mathematics, and can be satisfactorily used by those capable of draughtsmanship with mathematical instruments.—Dr. C. V. **Burton**: The spectroscopic resolution of an arbitrary function. An ordinary grating has periodic rulings, and a spectrum obtained by means of it is characteristic of the radiation entering the spectroscope-slit. But if the radiation is homogeneous, while the distribution of the rulings is arbitrary, we obtain a spectrum characteristic of the grating. It is thus found to be theoretically possible to resolve spectroscopically a given arbitrary function $\phi(x)$ into its harmonic constituents. The theory of the proposed method of resolving functions is discussed, and is as complete as that of ordinary spectroscopy, while in one respect it is more simple; for, since the light entering the spectroscope-slit is entirely of one wave-length, the comparison of intensities of spectral lines (whether visually or photographically) is facilitated.

Linnean Society, May 1.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Prof. P. **Groom** and W. **Rushton**: The structure of the wood of East Indian species of Pinus.—Dr. Winifred **Brenchley**: Branching specimens of *Lyginodendron oldhamium*, Will.—A. C. F. **Morgan**: A problem in Weismannism.—Mrs. L. J. **Wilsmore**: *Sphenopus marsupialis*.—Papers on collections made by the Percy Sladen expedition to the Indian Ocean:—Miss Helen L. M. **Pixell**: Polychæta of the Indian Ocean, with some species from the Cape Verde Islands. The Serpulidæ, with a classification of the genera Hydroides and Eupomatus.—S. **Hirst**: Report on the Arachnida of the Seychelles. Miss Marjorie **Lindsay**: *Gypsina plana*, Carter.—A. **Grouvelle**: Nitidulæ, Heteroceridæ.—A. **Raffray**: Pselaphidæ de l'Archipel des Seychelles.—Dr. K. **Jordan**: Anthribidæ of the Seychelles.—S. **Maulik**: Hispinæ from the Seychelles.—Dr. K. **Jordan**: Certain changes in nomenclature of Lepidoptera proposed by Dr. Verity.

Zoological Society, May 6.—Dr. Henry Woodward, F.R.S. vice-president, in the chair.—Dr. F. E. **Beddard**: The anatomy and systematic arrangement of the Cestoidea. This paper, the tenth of the series, contained an account of two species of tapeworms found in a Dongolan genet, both of which were described as new, one being made the type of a new genus.—J. A. **Milne**: Pacific salmon: an attempt to evolve something of their history from an examination of their scales. Reasoning from the similarity of their appearance to the scales of the other Salmonidæ, the author pointed out that all the migratory species except *Onchorhynchus kita* remain for at least a year in fresh water before proceeding to the sea—in the Fraser River district, at any rate. He also showed the scale of a quinnat, and pointed out that it was scarcely possible to avoid the conclusion that that fish had already spawned once before it was captured.—Miss Kathleen **Haddon**: Notes on *Peripatoides woodwardii*, Bouvier. This paper was based on material collected in Western Australia, consisting of twenty specimens, male and female, ranging in size from 17 to 46 mm., thus considerably exceeding in length those described by Prof. Bouvier. Various types of coloration are exemplified, some being blue-green with small yellow spots, while others have the yellow pigment increased, so as to give a tawny appearance to the animal; a dark variety of this latter type also occurs.—J. C. F. **Fryer**: Field-observations on the enemies of butterflies in Ceylon. It was concluded (1) that in Ceylon, with the exception of the

wood-swallow, birds are not formidable enemies to butterflies; (2) that owing to the propensity of the wood-swallow for members of the genera Danais and Euplœa, a resemblance to them would be not a safeguard but a danger.

Mathematical Society, May 8.—Prof. A. E. H. Love, president, in the chair.—Prof. W. **Burnside**: Some properties of groups the orders of which are powers of primes. Prof. H. S. **Carslaw**: The Green's function for the equation $\nabla^2 u + k^2 u = 0$.—Prof. W. H. **Young**: The usual convergence of a class of trigonometrical series. W. F. **Sheppard**: (1) Factorial moments in terms of sums or differences; (2) fitting of polynomials by the method of least squares.—S. **Lees**: The effect of internal friction on stress-strain relationships for elastic solids.

Royal Astronomical Society, May 9. Major Hills, C.M.G., F.R.S., president, in the chair.—Rev. A. L. **Cortie**: The mode of propagation of the sun's influence in magnetic storms. The author considered that the rays which proceed from the sun are not single kathode rays, as frequently assumed, but divergent. The solar corona as photographed at the eclipses of 1893, 1898, 1905, and 1908 showed systems of diverging rays apparently connected with spot groups. The study of these led to the conclusion that the mode of propagation of the influences which condition magnetic storms from the sun has the form of rays diverging from the foci of sun-spot disturbances. The sun-spots would not directly cause the storms, but rather condition them, perhaps by rendering the upper atmosphere a better electrical conductor.—H. **Kimura**: The harmonic analysis of sun-spot relative numbers. H. H. **Turner**: The harmonic analysis of Wolf's sun-spot numbers, with special reference to Mr. Kimura's paper. J. **Jackson**: The discordance between the observed and predicted positions of Jupiter's eighth satellite. The author made an appeal for further observations during the present year, which is a favourable occasion, as the satellite is now as much as 3° from the planet; the observations would have to be made in southern latitudes owing to the position of Jupiter.—R. A. **Sampson**: The correction of the field of a Newtonian reflector. The various defects of spherical aberration, coma, astigmatism, curvature of field, and distortion were separately dealt with, and an arrangement of three lenses was suggested, which would render the field of a Newtonian reflector practically perfect.—C. V. L. **Charlier**: An investigation on the motion of the stars.—**Royal Observatory, Greenwich**: The photographic magnitudes determined with the Greenwich astrographic equatorial; corrections depending on distance from the plate-centre.

PARIS.

Academy of Sciences, April 28.—M. F. Guyon in the chair.—A. **Haller** and Edouard **Bauer**: The methylation of *iso*valerone by means of sodium amide and methyl iodide. Tetramethyl*iso*valerone or 2:3:3:5:5:6-hexamethyl-4-heptanone. The di-, tri-, and tetramethyl*iso*valerones were isolated from the crude product of the reaction between sodium amide, *iso*valerone, and methyl iodide. The tetra-derivative was reduced to the corresponding alcohol by means of sodium and ethyl alcohol.—A. **Laveran** and M. **Marullaz**: Contribution to the morphological study of *Toxoplasma gondii* and of *T. cuniculi*. From the morphological point of view the differences between *T. cuniculi* and *T. gondii* are not sufficiently marked to justify their distinction into two species.—M. **Gouy** was elected a non-resident member, M. **Schwoerer** a correspondant for the section of mechanics (in the place of the late M. Dwelshauvers-Dery), and Prof. W. M. **Davis** a correspondant for the section of geography and navigation (in the place of the late Sir George Darwin).—M. **Simonin**: Results of the discussion of the observations made during the eclipse of the sun of April 16–17, 1912. From a discussion of all the available observations it is concluded that the first external contact was observed on the average six seconds too late, and the last contact three seconds too soon; the observations of the interior contacts appear to be free from systematic error.—G. H. **Hardy** and J. E. **Littlewood**: The Fourier's series of a squared function capable of summation.—Louis **Roy**: The movement of viscous media and quasi-waves.—Albert **Turpain**: The application of highly sensitive galvanometers to geodesy. A description of a special type of galvanometer capable of registering the time signals of the Eiffel Tower.—J. M. **Lahy**: The rectification of records deformed by the circular movements of the inscribing point.—Georges **Claude**: The absorption of neon by the electrodes of luminescent tubes. Neon is characterised by a remarkable resistance to absorption by the electrodes, as compared with helium or nitrogen. This fact is of practical importance in connection with the use of neon tubes for lighting purposes.—Ed. **Chauvenet** and G. **Urbain**: The density of the double salts. The case of the chlorides of copper and ammonium.—Jean **Bielecki** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by ketones, diketones, and the ketonic acids.—A. **Guyot** and A. **Kovache**: The action of formic acid upon the colouring matters derived from triphenylmethane.—Gustave **Chauveaud**: The evolution of the conducting apparatus in Veronica.—Raoul **Bayeux**: The comparative resistance of the dog and the rabbit to intravenous injections of oxygen. In proportion to its weight, the dog can tolerate in its veins a quantity of oxygen more than twenty-five times greater than a rabbit.—H. **Charrier**: Some modifications of the muscular tissue at the moment of sexual maturity in *Nereis fucata*.—Bernard **Collin**: A new Ellobiopsis, a parasite of *Parallobiopsis coutieri*. F. **Picard** and G. R. **Blanc**: A bacillary septicæmia in the caterpillars of *Arctia caja*.—R. **Marcille**: The use of ammoniacal salts in vinification. Musts deficient in volatile nitrogen and requiring an undue length of time for complete fermentation can be made to ferment normally by the addition of ammonium phosphate or sulphate.—H. **Dorlencourt**: Study on the urinary elimination of morphine injected into an animal not previously treated with the drug. A small proportion of morphine injected into the rabbit is always eliminated by the kidney. The morphine is recovered from the urine, unchanged, traces only of oxydimorphine being detected.—Ph. **Glangeaud**: The eight eruptive phases of the volcano of Puy de Côme.—M. **Aubert**: Beynes in prehistoric times.

May 5.—M. F. Guyon in the chair.—Armand **Gautier** and Paul **Clausmann**: Fluorine in the animal organism. The skin and its appendages. A method for the exact determination of minute amounts of fluorine was worked out by the authors and described about a year ago. This method is now being applied to the systematic examination of various parts of the body for the amount of fluorine. The results for the skin, hair, dental enamel, and nails are given in the present paper.—M. **Bazin** was elected a non-resident member.—Charles **Nordmann**: The effective temperatures of the stars. A comparison of the results obtained for twelve stars by Rosenberg and the author. Although

the methods used were based on different principles, with one exception (α Lyra), the agreement in the estimated temperatures is close, the differences being of the order of the experimental error. The results agree with the thermal classification of Sir Norman Lockyer, deduced from the qualitative study of stellar spectra.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the first quarter of 1913. Observations were possible on sixty-five days, and tables are given showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Th. **Anghelutza**: Some remarks on the exponential development of Cauchy.—G. **Bouligand**: Green's function for an indefinite cylinder.—M. **Hadamard**: Remarks on the preceding note.—J. de **Boissoudy**: The constant of the law of radiation.—G. A. **Dima**: The influence of the valency of the metal on the photoelectric effect of metallic compounds. In all the cases examined the compound in which the metal has the smallest valency appears to have the greatest photoelectric power.—Louis **Riéty**: The electromotive force produced by the flow of solutions of electrolytes through capillary tubes. Data are given for solutions of varying concentrations of potassium chloride, nitrate and sulphate, potash, hydrochloric and sulphuric acids.—C. **Gutton**: The determination of the time required for the establishment of electrical double refraction. The times found ranged from 0·6 to 1·4 hundred-millionth of a second. These are of the order of Maxwell's time of relaxation, and agree with the theory that double refraction is the result of a molecular orientation.—H. **Magunna**: A mechanical means for keeping tuning-forks or plates in continuous vibration.—Em. **Vigouroux**: The transformations of the alloys of iron and silicon. A discussion of a recent paper by G. Charpy and A. Cornu concerning the transformation point A_2.—G. **Reboul**: Chemical reactions and radii of curvature. It has been shown by the author that the chemical action of a gas on a solid depends on the form of the latter, the action being greatest at the points where the curvature of the solid is greatest. It is now found that if two copper wires of different diameter are placed close together in an atmosphere capable of forming a compound with the copper, the fine wire appears to exert a protective action on the coarser wire, the former only being attacked.—Camill **Matignon**: The preparation of barium. An intimate mixture of barium oxide and silicon in the proportion $3BaO:Si$ is heated in a steel tube to 1200° C.; barium is formed, and distils into the cooler portion of the tube. The yield is good, and the metal proved to be of 98·5 per cent. purity. Ferrosilicon with 95 per cent. silicon can replace the silicon.—M. **Hanriot** and A. **Kling**: The action of reducing agents on the chloraloses. Sodium and aluminium amalgams were used as reducing agents; compounds containing one and two atoms of chlorine were isolated and described.—A. **Wahl** and P. **Bagard**: Syntheses in the indigo group.—Marcel **Lantenois**: The preparation of carbon tetraiodids. Two methods were found practicable, the interaction of carbon tetrachloride and lithium iodide and the action of hypochlorite upon iodoform in strongly alkaline solutions. An advantageous method of purifying the crude product is given.—C. **Gaudefroy**: Dehydration figures.—Aug. **Chevalier**: The botanical origin of commercial Gabon woods.—J. **Beauverie**: The question of the propagation of rust in the Graminaceæ. The presence of mycelium, uredospores, or teleutospores of rusts in the interior of the seeds of cultivated Graminaceæ is very common, and it is necessary to take this fact into account in the study of the question of the propagation of rust.—E. **Perrot**: Observations on the preparation of cocoa. Improvements are suggested on the method of preparing the cocoa bean for the market in current use.—A. **Pinard** and A. **Magnan**: Researches on sexuality in births.—Henri **Béclère**: Pressure and thermometry in cryotherapy. An iron-constantan thermocouple has given good results, not only in determining the temperature in the freezing mixture (solid carbon dioxide), but also the temperature at the surface of application.—Pierre **Girard**: The osmotic relations of the red corpuscles with their medium: rôle of the electric state of the wall.—Auguste **Lumière** and Jean **Chevrotier**: The action of oxidising agents in general and alkaline persulphates in particular on the tetanus toxin. Remarks on a recent note by Marcel Belin. Details are given of the success attained in the treatment of tetanus by injections of sodium persulphate.—Jacques **Surcouf**: The transmission of the larvæ of *Dermatobia cyaniventris* by a mosquito.—Albert **Robin**: The retention of chlorides in the liver and the blood of cancerous subjects.—E. **Voisenet**: Cream of tartar as a food for the ferment causing bitterness in wine. The *Bacillus amaracrylus* can utilise sugars and glycerol as food, but is inactive in presence of tartaric acid and its salts.—G. **Malfitano** and Mlle. A. **Moschkoff**: Pseudo-crystals of starch and crystals of glucose.—H. **Labré** and R. **Maguin**: Contribution to the study of the conditions of precipitation of albumen by picric acid. Working with a constant excess of picric acid, the relation between the amount of albumen present and the quantity of picric acid combined with it is not a linear one, but can be represented by an equilateral hyperbola. The phenomenon would appear to be one of adsorption, but it can be made the basis of a practical method for the estimation of albumen.—Jean **Chautard**: The origin of petroleum at Wyoming.—J. **Bosler**: Magnetic storms and hysteresis phenomena.

BOOKS RECEIVED.

Ma Leçon—Type d'entraînement complet et utilitaire. By Lieut. G. Hébert. Pp. 208. (Paris: Vuibert.) 1.75 francs.

La Sécrétion Pancréatique. By E. F. Terroine. Pp. 133. (Paris: A Hermann et Fils.) 5 francs.

I Fenomeni Magnetici nelle Varie Teorie Elettromagnetiche. By Silvio Magrini. Pp. 165. (Bologna: N. Zanichelli.)

The British Empire with its World Setting. By B. Reynolds. Pp. viii+200. (London: A. and C. Black.) 1s. 4d.

English History Illustrated from Original Sources, 1715–1815. By H. E. M. Icely. Pp. xv+191+viii+107. (London: A. and C. Black.) 2s.

Elementary Algebra. By C. Godfrey and A. W. Siddons. Vol. ii. Pp. xi+227–530+xlvi. (Cambridge University Press.) With answers, 2s. 6d.; without answers, 2s.

Four-Figure Tables. By C. Godfrey and A. W. Siddons. Pp. 40. (Cambridge University Press.) 9d. net.

The Seashore I Know. Edited by W. P. Westell and H. E. Turner. Pp. 80. (London: J. M. Dent and Sons, Ltd.) 8d. net.

Continuous Beams in Reinforced Concrete. By B. Geen. Pp. iv+210. (London: Chapman and Hall, Ltd.) 9s. net.

Die deutschen Salzlagerstatten. By Dr. C. Rie-

mann. Pp. 97. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Die neueren Warmekraftmaschinen. II., Gaserzeuger, Grossgasmaschinen, Dampf- und Gasturbinen. By Prof. R. Vater. Pp. vi+116. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Introductory Electricity and Magnetism. By C. W. Hansel. Pp. xv+373. (London: W. Heinemann.) 2s. 6d. net.

Sex Antagonism. By W. Heape. Pp. 217. (London: Constable and Co., Ltd.) 7s. 6d. net.

Dent's Practical Notebooks of Regional Geography. By Dr. H. Piggott and R. J. Finch. Part ii., Asia. Pp. 64. (London: J. M. Dent and Sons, Ltd.) 6d. net.

The Conception of a Kingdom of Ends in Augustine, Aquinas, and Leibniz. By E. H. Stokes. Pp. iv+126. (Chicago: University of Chicago Press; Cambridge University Press.) 3s. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 41 and 42. (Jena: G. Fischer.) 2.50 marks each Lief.

Canada. Department of Mines. Geological Survey. Memoir No. 17E. Geology and Economic Resources of the Larder Lake District, Ont., and Adjoining Portions of Pontiac County, Quebec. By M. E. Wilson. Pp. vii+62+xi plates. (Ottawa: Government Printing Bureau.)

Manual of Qualitative Analysis: Reagent and Combustion Methods. By W. F. Hoyt. Pp. vi+35. (London: Macmillan and Co., Ltd.) 1s. 3d. net.

The Oxford Geographies:—An Introduction to Plant Geography. By Dr. M. E. Hardy. Pp. 192. (Oxford: Clarendon Press.) 2s. 6d.

Mineral and Aerated Waters. By C. A. Mitchell. Pp. xiii+227. (London: Constable and Co., Ltd., 8s. 6d. net.

The Pathology of Growth. Tumours. By Dr. C. P. White. Pp. xii+235. (London: Constable and Co., Ltd.) 10s. 6d. net.

DIARY OF SOCIETIES.

FRIDAY, MAY 16.

ROYAL INSTITUTION, at 9.—The Pygmies of New Guinea: Captain C. G. Rawling.

PHYSICAL SOCIETY, at 8.—Some Experiments to Detect β rays from Radium A.: Dr. W. Makower and Dr. S. Russ.—Dust Figures: Dr. J. Robinson.

SATURDAY, MAY 17.

ROYAL INSTITUTION, at 3.—Humphrey Internal Combustion Pumps: H. A. Humphrey.

TUESDAY, MAY 20.

ROYAL INSTITUTION, at 3.—Recent Advances in the Production and Utilisation of Wheat in England: Prof. T. B. Wood.

ROYAL STATISTICAL SOCIETY, at 5.—The Census of Ireland, 1911: Sir W. J. Thompson.

ZOOLOGICAL SOCIETY, at 8.30.—Notice of Some Important Works on Zoological Nomenclature Now in Progress: Rev. T. R. R. Stebbing.—Observations on the South African Rhynchocephaloid Reptile Euparkeria and Allied Genera: Dr. R. Broom.—Experiments on the Metamorphosis of the Axolotl (*Amblystoma tigrinum*) conducted in the Society's Gardens: E. G. Boulenger.—Some Cases of Blindness in Marine Fishes: G. E. Bullen.—The Patella in the Phalacrocoracidæ: Dr. R. W. Shufeldt.

WEDNESDAY, MAY 21.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45.—Reception of Members of Captain Scott's Antarctic Expedition. Lecture by Commander E. R. G. R. Evans, R.N.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Determination of the Radiation of the Air from Meteorological Observations: E. Gold.—Results of Monthly and Hourly Cloud-form Frequencies, at Epsom, 1903–1910: S. C. Russell.

AERONAUTICAL SOCIETY, at 8.30.—Wilbur Wright Lecture.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Annual Exhibition of Microscopic Aquatic Life.

THURSDAY, MAY 22.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Rays of Positive Electricity: Sir J. J. Thomson.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. I. Molecular Architecture: Prof. W. J. Pope.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.

CONCRETE INSTITUTE, at 4.30.—Annual General Meeting.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, MAY 23.

ROYAL INSTITUTION, at 9.—The Secret of the Permanent Magnet: Prof. S. P. Thompson.

SATURDAY, MAY 24.

ROYAL INSTITUTION, at 3.—Radio-activity. I. The α Rays and their Connection with the Transformations: Prof. E. Rutherford.

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Editorial and Publishing Offices:
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...DEX.

Royal Society of London Catalogue of Scientific Papers, 1800–1900. Subject-Index, Vol. iii., Physics. Part i., Generalities, Heat, Light, Sound. Pp. c + 550 + vii. (Cambridge University Press, 1912.) Price 18*s*. net.

THE most obviously essential qualities of a work of reference such as this are accuracy, comprehensiveness, and a lucid arrangement of the contents, so that anyone using the book may readily find the information he is in search of. The test of accuracy must lie in the result of long usage, but, in the present case, so far as an *a priori* guarantee can go, we have it in the auspices under which the book is produced. As to comprehensiveness, while absolute completeness is no doubt unattainable, most of those who have occasion to consult the work before us will be satisfied with the statement that it "contains 33,344 entries referring to the papers contained in 1261 serial publications." Even these numbers convey little idea of the comprehensive scale of the whole book of which the volume we are considering forms a part, unless it is borne in mind that it deals with only those parts of the science of physics which are included under the headings generalities, heat, light, sound, leaving the great subjects electricity and magnetism for another volume, and unless we remember, further, that the whole of physics constitutes only one of seventeen sciences included in the schedule of the International Catalogue. These sciences are mathematics, mechanics, physics, chemistry, astronomy, meteorology, mineralogy, geology, geography, palæontology, biology, botany, zoology, anatomy, anthropology, physiology, and bacteriology.

The volume relating to pure mathematics was published in 1908 and contains 38,748 entries referring to 700 serials, and the volume on mechanics, published in 1909, contains 21,295 entries referring to the papers contained in 959 serials. This makes a total of 93,387 entries contained in the three already-published volumes of the catalogue, or, if we assume that the second half of "Physics" will yield as many as the first half, we get an estimated total of more than 126,000 entries for the first three sciences in the above list. Of the remainder, some will no doubt provide a smaller number than the average of those already dealt with, but others will probably furnish quite as many. This may suffice to give some idea of the comprehensive character and immense scale of the work which the Royal Society's committee has undertaken in the compilation of this catalogue.

The arrangement of the matter has obviously required very careful consideration. A purely alphabetical arrangement of such an immense number of entries relating to such a great variety of subjects would clearly have resulted in a series of bewildering lists wherein the search for a particular item would have been like that for a needle in hay. The arrangement actually adopted is founded on an elaborate attempt at a rational classification of the subject-matter of the sciences dealt with. This is carried out by a series of successive divisions and subdivisions, the nature of which can be best shown by an example. Thus the general subject of Heat is first distributed among the following main divisions: General; Sources of Heat and Cold; Thermometry; Relations involving Expansion and Stress; Calorimetry and Specific Heat; Phenomena of Change of State; Thermal Conduction and Convection; Thermo-dynamics. Each of these main divisions is subdivided into numbered headings; thus, to take a comparatively compact example, Calorimetry and Specific Heat comprises the following headings: 1600, General, Units of Heat; 1610, Calorimetric Methods; 1620, Specific Heats of Solids and Liquids; 1640, Specific Heats of Gases and Vapours; 1660, Chemical Constitution and Specific Heat; 1670, Heats of Fusion; 1680, Heats of Vaporisation; 1690, Heats of Dissolution; 1695, Heats of Transformation.

The numbers greatly facilitate cross-reference. It will be seen that they do not run continuously and that the intervals between them are not uniform. These intervals make it possible to expand the index in future by inserting additional entries without disturbing those to which numbers have already been assigned. For some rather occult reason the reference numbers all have four figures, the first half-dozen being 0000, 0010, 0020, 0030, 0032, 0040. These numbered headings are in most cases again subdivided, sometimes to a considerable extent, before we come to the references to individual papers.

The extreme terms of this series of divisions and subdivisions, namely, a branch of science and a particular paper relating to some matter falling under this branch, are determined by the nature of the case: but there is room for almost any amount of difference of opinion as to how many intermediate terms should be interposed, and where they should be placed. The ultimate criterion in this matter should be, in our opinion, the degree of ease and convenience with which a

student wishing to follow up a particular subject can find references to what has been already published in relation to it. To facilitate this kind of reference is, in fact, the whole purpose of the book. Some degree of arrangement and classification of contents is needful to make the index usable at all, and this begins when one science is marked off from another; but the more minutely the classification is carried out, and the smaller the resulting classes become, the more chance there is of uncertainty as to the class in which a particular paper should be placed. If the question is answered in one way by the compilers of the index and in another way by a person who wishes to use it, the natural consequence is that he does not find the information he wants in the place he turns to first. The fact is that any possible classification is in a great degree arbitrary and conventional. The grouping of scientific results that at any time seems most natural and logical inevitably reflects not only the then existing state of knowledge, but also the successive stages by which that state of knowledge has been reached. New additions to scientific knowledge are not like bricks added to a building each of which occupies a fixed position and a sharply defined space; each newly recognised fact sheds light on what was known before and may greatly alter the apparent relative importance of previous acquisitions.

That such considerations are not irrelevant to the arrangement of this index is shown by the entry of thirteen references to papers on heat developed on moistening solids, under the general heading **0300 Capillarity,** and also under **Phenomena of Change of State, 1800 General.** There are, in fact, hosts of phenomena which are essentially related to more than one division of science, and papers dealing with them must necessarily be entered under more than one heading unless the index is to be encumbered by a tangle of cross-references.

We are fully conscious that the Royal Society's committee and the compilers of the index, who have considered the matter as a whole, may have good reasons for deciding on subdivisions and schemes of arrangement the advantages of which are not at once evident to anyone who has only partially examined a part of their work. It is therefore with the greatest diffidence that we venture to raise the question whether the classification on which the arrangement of the index is founded is not in some cases too minute. Thus the first entry under the heading **2410, Mechanical Equivalent of Heat,** gives a reference to Joule's classical paper in the Philosophical Transactions for 1850, and lower down, under the same general heading, we find references to Rowland's determination and to Reynolds and Moorby's; but Joule's final measurement (Phil. Trans., 1879) is given under a separate sub-heading, **Determination of Mechanical Equivalent,** under which we also find Griffiths (Phil. Trans., 1894), Miculescu (1892), and many others, and, under a sub-sub-heading, "Electrical Method," Joule's determination of 1867. We do not doubt that there are intelligible reasons for the separations and collocations of which these are examples, but we confess that to us personally they are more bewildering than helpful. For a long time we were not able to find any reference to Schuster and Gannon's measurement by the "electrical method," but at last we discovered it, as well as Rowland's and various other determinations, under "Specific Heat of Water." This is quite an appropriate place, but it is not easy to see why this paper should not also have been entered among determinations of the mechanical equivalent.

It is no doubt in consequence of our not having mastered the classification adopted by the committee that we have not been able to find references to such historically important investigations as those of Dulong and Petit into the expansion of mercury, the laws of cooling, and the specific heats of metals. The real difficulty of finding a thoroughly satisfactory system of arrangement arises partly from the enormous mass of material to be dealt with, but still more from the extreme complexity of the material. A strictly alphabetical arrangement offers an alluring simplicity, but a very slight examination of the contents of this volume must convince anyone that it would be hopeless to apply it until the matter has undergone a preliminary process of arrangement and sifting. The only questions that can arise are as to how this process shall be conducted, and how far it shall be carried; and probably scarcely any two men would answer these questions in exactly the same way.

There is no question that the index is a very remarkable and admirable piece of work, on which the Royal Society's committee, the director, Dr. McLeod, and all his colleagues deserve to be heartily congratulated. It will not only be of immense service to those engaged in the study of special questions, but it will help to keep alive a knowledge of the work of the men who laid the foundations of physical science. This work, like foundations generally, is apt to be buried out of sight as the superstructure rises, but it is well that modern builders should cherish the memory of those who made their work possible.

We find it difficult to close this volume without comparing it with Dr. Thomas Young's "Catalogue of Works relating to Natural Philosophy and

the Mechanical Arts," published a little more than a century ago (1807), which, for its time, and as the work of one man, was as wonderful as the present index. The comparison affords a more trustworthy indication of the advance of natural knowledge during the nineteenth century than could probably be obtained in any other way.

G. C. F.

A NEW TEXT-BOOK OF MINERALOGY.

Mineralogy: an Introduction to the Theoretical and Practical Study of Minerals. By Prof. A. H. Phillips. Pp. viii+699. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1912.) Price 16*s*. net.

PROF. PHILLIPS'S text-book on mineralogy follows, on the whole, the usual lines of such works, and in price and size comes intermediately between Miers's well-known treatise, which appeared eleven years ago, and Dana's small book, a new edition of which, prepared by Ford, was published recently. By his experience in teaching the subject the author is well qualified to write a book suitable for students who wish to acquire a sound working knowledge of mineralogy.

As will be evident from the titles of the three parts into which it is divided, viz., crystallography, descriptive mineralogy, and determinative mineralogy, the book is comprehensive in its scope. Since each forms a subject wide enough to fill a book in itself, the author of a work dealing with all three is confronted with the difficulty of deciding how to keep the size within reasonable dimensions. On the whole, Prof. Phillips has succeeded in well covering all the ground necessary for the average student of mineralogy. We must acknowledge a debt of gratitude to him for resisting the temptation—irresistible to most writers on crystallography—of devising a brand new set of names for the thirty-two classes of crystal symmetry; he has wisely followed Miers, because the latter's nomenclature embodies the type of symmetry, and is therefore more easily remembered. Some surprise may be felt that little trace of Penfield's teaching should be evident in the discussion of the method of drawing crystals; the old one, in which an axial-cross is used, alone is considered, and no mention is made of the simple and convenient methods based upon the stereographic or gnomonic projections.

The whole subject of the goniometrical measurement of crystals is treated in a very elementary manner, and is confined to the instrument with a single circle; the theodolite goniometer, with two circles, which is used by many crystallographers in the United States, especially those who have studied under Goldschmidt, is not referred to, and it would seem that few students at Princeton University prosecute their studies very deeply into crystallography. The optical characters of crystals, on the other hand, are more fully dealt with, the reason no doubt being that an adequate knowledge is essential to the practical petrologist in the determination of the constituent minerals of a rock from a microscopic study of a thin-section.

The first part includes an interesting chapter on the relations of individual crystals, in which attention is directed to the parallel growths of one mineral on another, the full importance of which subject has largely been brought out by Barker's researches during recent years.

The second part includes three chapters which we should have imagined more in place in the first part, viz., the relation of the minerals to the elements, which covers such matters as topic parameters and the classification of minerals, the origin of minerals, and, lastly, the physical properties—for instance, cleavage and fracture, hardness, specific gravity, structure, colour, phosphorescence, &c. The part proper is devoted to concise descriptions of the characters and localities of the principal mineral species. At the head we have an abstract of their properties—chemical composition, crystalline system and type of symmetry, common forms, hardness, specific gravity, streak, colour, lustre, transparency, refractive indices—and then follows a general description of the crystals from the principal localities; in certain instances a few words are said about the use of the mineral or the metal derived from it.

Part iii. is given up to the methods of blowpipe analysis, the apparatus used, and the tables necessary for the identification of the various minerals, and is founded on Brush's well-known book. The tables provided include also one for the determination of minerals from their physical characters, dependence being placed mainly upon the hardness, streak of the softer and colour of the harder minerals, specific gravity, and cleavage, and another for the determination of the principal rock-forming minerals from their optical characters as given in a thin-section. The book ends with a full index, the use of which is facilitated by the employment of a different type for the numbers of the pages in each part of the book.

So far as we have tested it, the book seems satisfactorily accurate. Two curious mistakes have, however, crept into the description of the Cullinan diamond, the date of the discovery being wrongly stated to be June 6, instead of January 25, 1905, and the weight given being too high.

HEREDITY AND RELATED STUDIES.

(1) *Vererbungslehre. Mit besonderer Berücksichtigung des Menschen, für Studierende, Aerzte und Zuchter.* By Dr. Ludwig Plate. Pp. xii+519+3 plates. (Leipzig: W. Engelmann, 1913.) Price 18 marks.

(2) *Genetics: An Introduction to the Study of Heredity.* By Prof. H. E. Walter. Pp. xiv+272. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6s. 6d. net.

(3) *The Fitness of the Environment: An Inquiry into the Biological Significance of the Properties of Matter.* By Prof. L. J. Henderson. Pp. xv+317. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6s. 6d. net.

(4) *Moderne Probleme der Biologie.* Prof. C. S. Minot. Pp. vii+111. (Jena: Gustav Fischer, 1913.) Price 3 marks.

(5) *Vorträge über Deszendenztheorie.* By August Weismann. Dritte umgearbeitete Auflage. Erster Band and Zweiter Band. Pp. xiv+342+vii+354+3 plates. (Jena: Gustav Fischer, 1913.) Price 13 marks.

(1) PROF PLATE'S excellent book gives a clear and comprehensive account of the present state of the study of heredity. The author is already known as an experimental investigator on the genetics of coat colour in mice, and as a student of heredity in man. Moreover, as the volume shows, he has a wide knowledge of the literature. The chief feature of the book, in which it differs most from works of a kindred nature, is the amount of space allotted to human heredity. Nearly one-fifth of the book is devoted to this subject, and most cases of which anything is known in man come in for review. It is certainly the best general account of this side yet written, and for this reason, if for no other, should be of special value to students of eugenics and to medical men. We notice that the author still adheres to the ingenious theory which he put forward some two years ago to account for the peculiar phenomena of inheritance in cases such as colour-blindness and hæmophilia, where the unaffected females transmit the affection to their sons. The theory is largely based upon the unusual proportions of the sexes in certain matings among such families. Lenz, however, has recently suggested that these proportions are due to the way in which the material is necessarily selected, and that Plate's explanation is probably incorrect. The volume is attractively and clearly written, and is well illustrated with more than 170 figures and three coloured plates.

(2) Prof. Walter states explicitly in his introduction that he is not engaged in research in the subject of which he treats. The book professes to be but a summary which may be useful in college courses, and of interest to the general reader, nor does the author aim at more than "out of the jargon of many tongues to raise a single voice which shall attempt to tell the tale of heredity." As a tale to be told the book cannot be judged a success. It gives one the impression of lecture notes carefully taken and displayed under appropriate labels. There is a little about much, and on the whole the information given is sound second-hand. The only attempt at originality is to be found in some of the diagrams. It is always refreshing to get away from the hackneyed stock but we cannot help feeling that in some cases the author has got a little too far away. Fig. 2 is intended to illustrate the continuity of protoplasm, but it inevitably challenges comparison with a Cubist picture. Fig. 31, "a diagram to illustrate various ideas about species," calls to mind what is occasionally to be seen in an elementary student's notebook naïvely labelled "Amœba," while fig. 45 looks like the plan of a theatre auditorium somehow disarticulated. But perhaps it is ungrateful to criticise originality, and the book will doubtless be found of use by the student who wishes to "get up" the subject for examination in the shortest time.

(3) The genesis of this volume is explained in the opening sentences of the preface.

"Darwinian fitness is compounded of a mutual relationship between the organism and the environment. Of this, fitness of the environment is quite as essential a component as the fitness which arises in the process of organic evolution; and in fundamental characteristics the actual environment is the fittest possible abode of life. Such is the thesis which the present volume seeks to establish."

Rather on the lines of the old Bridgewater treatises, which he has evidently studied, the author proceeds to argue that the more recent discoveries in the realms of physics and chemistry all confirm the idea that from the inorganic side this is the fittest of all possible worlds to form an environment for living matter. Water in respect to all its many properties is the fittest of fluids to exist in the quantities that it does, and in the author's opinion it would be to introduce a serious element of unfitness were it replaced, for example, by liquid ammonia. Carbon dioxide also shows itself

"in its physico-chemical traits variously fitted for the organic mechanism. Less various, to be sure, and less obvious than those of water, such fitnesses as it does possess are quite as genuine."

Of the three elements carbon, hydrogen, and oxygen, the author concludes that:

"Each by itself, and all taken together, possess unique and preeminent fitness for the organic mechanism."

Nor is the ocean forgotten, but comes in for a whole chapter and a warm encomium. The latter part of the book is devoted to a discussion on vitalism and teleology, and the author uses the "fitness" of things physical as an argument for a mechanistic interpretation of things organic. For the "fitness" of the physical world appears to imply teleology. Nevertheless, mechanism is enough. Hence the semblance of teleology is misleading, and therefore mechanism must suffice for biology also. Perhaps Dr. Henderson's position with regard to vitalism may best be illustrated by the remark of Laplace, which he himself quotes. When the philosopher was asked by Napoleon why the name of God did not occur in his *Mécanique céleste* he replied: "Sire, je n'ai pas besoin de cet hypothèse."

(4) Prof. Minot's book is the outcome of six lectures delivered by him at Jena in the capacity of "Exchange-Professor." After a preliminary lecture on the nature of cells he develops his views on the changes that occur in the life cycle from fertilisation until death. With fertilisation comes the inception of a process of rejuvenescence characterised by the formation of a number of undifferentiated cells, and with a great proportional increase in the total amount of nuclear material in the organism. Then comes a stage where the tissues develop, where they undergo a process of differentiation or cytomorphosis, as the author terms it. This is eventually followed by degeneration and ultimately by death. Death is the price paid for differentiation. Such is the tale. We rot and rot, but Prof. Minot sees the rotting starting earlier than the poet does. Senescence is the outcome of cytomorphosis, and as this is most active in comparatively early embryonic stages it follows that we are rotting most rapidly before we are born. After that we are let down more gently. The book rambles a good deal, and a chapter is devoted to the determination of sex, though it seems scarcely germane to the main thesis. Possibly it owes its place to its being an attractive subject for a course of semi-popular lectures.

(5) The last edition of this well-known work appeared in 1904, and was reviewed in NATURE for June 29, 1905. The greater part of the present edition is a reprint of the earlier one, but in one respect there is a change. Lectures 22–24, dealing with heredity, have been rewritten, and a fresh lecture added. The change was necessitated by the great progress made in these studies during the past few years owing to the discovery of Mendel's work. Weismann's second edition appeared four years after that discovery, and the matter was then dismissed in a few lines. To-day the position is accepted, and the author endeavours to bring the new facts into line with his theory. That the conception of segregation fits in a general way with his views on the nature of chromosomes is obvious. But, as he himself recognises, difficulties begin to appear as soon as the matter is more carefully considered.

One of the difficulties at the root of the chromosomal interpretation of hereditary factors is the fact that in some species already, *e.g.* Triticum, Lathyrus, and Antirrhinum, the number of factors identified is greater than the total number of chromosomes. Some investigators, notably Morgan, have sought to reconcile such cases with the chromosome hypothesis by means of Jansen's theory of "chiasmatypie," while others are inclined to question the sufficiency of the chromosome theory to explain segregation. Fresh facts, however, must decide the matter, and it is likely that the next few years will be critical years for Weismann's views. The present volume is of historical interest in showing the attitude of a great speculative mind when brought to face a new and unfamiliar body of facts, and it is much to be regretted that in shaping their interpretation a brain of such synthetic capacity is little likely to be available.

VON RICHTHOFEN'S "CHINA."

China: Ergebnisse eigener Reisen und darauf gegründeter Studien. Von Ferdinand Freiherr v. Richthofen. Dritter Band. Das südliche China. Herausgegeben von Ernst Tiessen. Pp. xxxi+817+5 plates. Fünfter Band. Enthaltend die abschliessende palaeontologische Bearbeitung der Sammlungen F. von Richthofens, die Untersuchung weiterer Fossiler Reste aus den von ihm bereisten Provinzen sowie den Entwurf einer erdgeschichtlichen Uebersicht China's. By Dr. Fritz Frech. Pp. xii+289+31 plates.

Atlas von China. Orographische und geologische Karten von Ferdinand Freiherr von Richthofen, zu des Verfassers Werk "China: Ergebnisse eigener Reisen und darauf gegründeter Studien." Zweite Abtheilung. Das südliche China (zum dritten Textband gehörig). Bearbeitet von Dr. M. Groll. Pp. 12+plates 27–54. (Berlin: Dietrich Reimer, 1911–13.) Price, Bands III. and V., 32 marks; Atlas, 52 marks.

THESE volumes complete what may well be called the monumental work of Baron v. Richthofen on China, for the word is equally appropriate whether we regard the extent and

importance of his researches, which will stand for all time as the foundation of our knowledge of the geology of the Chinese Empire, or whether we regard the fact that the author himself was only able to publish a portion of his work, the greater part having been prepared for and put through the press by the devoted industry of his friends and former pupils.

Of the two volumes before us, one contains v. Richthofen's account of his travels through southern China, edited and amplified by references to the observations of later travellers by E. Tiessen. These additions are most extensive in the account of the salt and gas fields of the upper Yangtsekiang, which v. Richthofen was prevented from visiting, where the ingenuity and indomitable perseverance of the Chinese have enabled them, in spite of the primitive nature of their appliances, to rival the achievements of the modern driller and to obtain a supply of natural gas from depths of 2000 ft. and even 3000 ft. The detailed observations of so acute an observer must always be of interest, and although all the more important results of his journey have already been published in one form or another, we welcome the completion of publication of the record, which will always be of importance and value to the student of the geology and physical geography of Eastern Asia.

The other volume is entirely the work of Dr. Fritz Frech, to whom Baron v. Richthofen entrusted the elaboration of the palæontological material collected by him. The description of the fossils is supplemented by a series of essays on the distribution and development of the different rock systems in China and Eastern Asia, and by a general review of the geographical evolution and the geological history of sea and land in China.

OUR BOOKSHELF.

Die gnomonische Projektion in ihrer Anwendung auf kristallographische Aufgaben. By Dr. H. E. Boeke. Pp. iv+54. (Berlin: Gebrüder Borntraeger, 1913.) Price 3.50 marks.

THIS little book on the gnomonic projection of crystals is a welcome addition to crystallographic literature. The standard work on the subject, "Ueber Projektion und graphische Kristallberechnung," by Prof. V. Goldschmidt, of Heidelberg, was published in the year 1887, before the advent of the two-circle goniometer, which has both simplified the method and enlarged the field of usefulness of the gnomonic projection. The greater number of the subsequent improvements in the method we owe to Dr. G. F. Herbert Smith, Mr. H. Hilton, Dr. A. Hutchinson, Dr. J. W. Evans, Sir Henry Miers, Prof. von Fedorow, and Prof. F. E. Wright.

The gnomonic differs from the stereographic projection in that the plane of projection is a tangent plane to the sphere (within which the crystal is supposed to be concentrically situated), and the eye is imagined to be placed at the common centre of the sphere and crystal; while in the stereographic projection the eye is situated at the north or south pole of the sphere, and the plane of projection is that containing the equatorial great circle. Just as we have the most useful stereographic nets of Hutchinson, Penfield, and von Fedorow, so we have the gnomonic net of Hilton, and Herbert Smith has furnished us with a table to facilitate the plotting of the gnomonic diagram from the results of the measurements of the crystal made on the two-circle goniometer, an excellent type of which he has invented. With the exception that no mention appears to be made of the important work of Herbert Smith (no index is provided), Prof. Boeke has given in the concise space of fifty-four pages a very fair account of the principles of the method, together with some useful tables of chords and tangents. The illustrations are simple ones from original drawings of the author, and are very practical, but an obvious omission is that of a few typical gnomonic projections of fairly complex crystals belonging to each system of symmetry. Such a series of concrete examples would have afforded students a more comprehensive idea of the scope, possibilities, and actual application of the gnomonic projection.

A. E. H. T.

The Extra Pharmacopoeia of Martindale and Westcott. Revised by Dr. W. Harrison Martindale and Dr. W. Wynn Westcott. Fifteenth edition. Vol. i., pp. xxxi+1114. Price 14*s.* net. Vol. ii., pp. viii+370. Price 7*s.* net. (London: H. K. Lewis, 1912.)

THIS valuable work has now reached its fifteenth edition, eloquent testimony of its worth. The subject-matter has grown to so great an extent that it has been necessary to divide it into two volumes: the first, of more than 1000 pages, contains the description of the chemicals and drugs and the sections on vaccine and serum therapy, therapeutic index, &c.; the second embodies analytical and experimental work and a *résumé* of investigations on infective and other diseases. For the medical man and pharmacist, the book contains a wealth of information scarcely to be found in any other work, while numerous data are scattered through it which render it a volume of reference which will be found of the greatest service in the chemical and the biological laboratory.

R. T. H.

Practical Physiological Chemistry. By S. W. Cole. Third edition. Pp. xii+230. (Cambridge: W. Heffer and Sons, Ltd., 1913.) Price 7*s.* 6*d.* net.

UNDER the title "Practical Exercises in Physiological Chemistry," this book was reviewed in the issue of NATURE for March 2, 1905 (vol. lxxi., p. 412). In the present edition Mr. Cole directs particular attention to analytical methods. He urges that medical students should be taught the micro-chemical methods of urinary analysis introduced by Folin, and that more conclusive qualitative methods should replace Fehling's sugar-test.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Reflection of X-Rays and Related Phenomena.

In a letter to NATURE of April 17, M. de Broglie described bands or fringes observed in the photographs produced by reflection of X-rays on certain crystals. Further experiments seem to show that there are two or even three different types of bands present, which must be attributed to different causes.

First, there is the ordinary dispersion, with the difference that in the case of a three-dimensional grating the spectrum of the primary beam, presumably continuous within certain limits, will appear as a series of bands as certain wave-lengths are destroyed by interference. This would lead to an apparently abnormal lengthening of the spots at a distance from the centre, which has, in fact, been observed. It would not, however, account for bands in the principal regularly reflected spot.

Secondly, the bands of interference described by Hupka and Steinhaus must be present whenever the primary beam is divergent. As was to be expected, these appear to be present in all the spots if the focus of the kathode rays on the anti-kathode is sufficiently small. They seem to indicate the existence of X-rays of considerably shorter wave-length than the average wave-length in the primary beam, and may possibly be due to fluorescent radiation.

Thirdly, very strongly marked bands are often observed, which must probably be attributed to invisible cracks along the planes of cleavage in the crystal. In certain circumstances the movement of the focus of the kathode rays in consequence of changes of hardness in the tube may enhance this effect. The fact that the bands are nearly equidistant in a large number of different crystals of the same substance might possibly be attributed to the varying velocity of growth of the crystal on account of the seasonal changes during its formation.

As M. de Broglie pointed out, analogous figures to those obtained by photographing the reflection of X-rays on cubic crystals may be produced by reflection of visible light on a square crossed grating. Laue's theory, which seems to be equivalent to Bragg's, if one assumes cubical packing, shows that only a limited number of lines of definite wave-lengths appear on the plate if one has a three-dimensional grating or space-lattice. Reflection on some crystals, *e.g.* the base of a prism of phosgenite, $(PbCl)_2CO_3$, appears to show all the spots a two-dimensional grating would lead one to expect, *i.e.* only the surface layer appears to come into play. Whether this is due to its opacity to X-rays or to the fact that the mean distance apart of the atoms in the direction vertical to the reflecting plane may be an irrational fraction of the distance in the reflecting plane, has yet to be investigated. If, however, one accepts the hypothesis that we have here reflection on the surface layer only—an hypothesis which the number and position of the spots would seem to justify—then we have in this case true spectra of the X-rays emitted by the tube and not, as in Laue's experiments, X-rays of definite wave-lengths sorted out by the grating. The spectra appear to comprise about one octave with a mean wave-length of $\lambda = 0{\cdot}037c$, where c is the distance of two neighbouring reflecting atoms. It appears difficult to obtain good photographs with this crystal, as with most others containing elements of high atomic weight. This may be due to the increased amount of secondary fluorescent radiation and to the greater sensitiveness of the photographic plate to these rays.

The examination of a series of crystals of the regular system confirmed the consequence of all theories and the experiments of various physicists, that the figures obtained must depend only on the position of the plate and the crystal with respect to the primary beam. It is difficult to give definite data as to the reflecting power of different crystals, though it seems that it may be taken as a general rule that those composed of elements of lower atomic weight reflect better than those containing heavier atoms. The relative intensity of different spots varies in different crystals, probably according to the distribution of energy amongst the different wave-lengths in the primary beam. But even in one and the same crystal the intensity of different spots varies according to its position. Thus with an ordinary square crossed grating the spectra are at the points of intersection of a series of concentric circles and hyperbolæ. By turning the grating in its own plane by 45° the circles open out into hyperbolæ and *vice-versâ*. When the plane of incidence is parallel to the lines in the grating spots of equal brilliance are on the circles; at 45° the same spots, still of equal brightness, are on the hyperbolæ. The same experiment carried out with X-rays reflected on rock-salt shows that the spots of approximately equal brightness are on the circles.

M. DE BROGLIE.
F. A. LINDEMANN.

Stratigraphical Problems in New Zealand.

Though I do not in any way object to the review of my book on the geology of New Zealand published in NATURE (January 30, p. 591), I should like to explain further one or two points, as, from the manner in which they are quoted in the review, they are obviously open to misapprehension.

It is stated that "it is hard to comprehend why unconformity should be demanded as a proof of the distinction between two successive geological systems." The fact is that those who have wished to split the system of our younger rocks into distinct parts have insisted upon the existence of unconformities. Careful work has, I think, now shown conclusively that such breaks do not occur in these rocks. It is therefore the wish of some of us to represent these rocks as in fact they are: a simple conformable sequence. The lithological nature of all the lower members shows that they were deposited during a uniform and continuous movement of depression.

It is true that the lowest members of this sequence contain Cretaceous fossils. These Cretaceous sediments are followed by a considerable thickness (500 to 2000 ft. in different sections) of unfossiliferous rocks. Cainozoic fossils then begin to appear—in small numbers at first—but soon a luxuriant Miocene molluscan fauna is developed. It is, however, well to bear in mind, as is frequently mentioned by Hutton, that several of the genera appear in the Eocene sediments of Australia. Associated with the "Miocene" mollusca is an echinoid fauna consisting of thirty-two members, which, in a critical article by Tate, is said to be Eocene with a Cretaceous complexion; at any rate, all the members of it are extinct.

The point on which I wish to insist is this. All the lower members of this conformable sequence were deposited during the continuance of uniform physical conditions and in direct continuous succession. Some time after the Cainozoic fauna had appeared elevation commenced. A series of rocks deposited under such conditions should surely constitute a geological system

in the country in which it occurs, even though it cannot be properly packed into European compartments.

My statement that "too much attention has been paid in the past to the palæontological evidence" is, when removed from its surroundings, obviously absurd. The point I wished to emphasise is merely that correlation based upon homotaxis can be pushed too far, and that it is unscientific to break up a uniform series of rocks that occurs in New Zealand into sharply separated divisions on the basis of the occurrence of fossils that in Europe are found at different horizons. It is in this sense only that I suggest that too much emphasis has been laid on the palæontological evidence in the past in New Zealand, especially as all the collections of fossils are still far from complete. I may add that for twenty years, owing to the influence of my old and revered teacher, the late Capt. Hutton, F.R.S., I endeavoured to apply his divisions of the younger rocks of New Zealand to the districts where I was at work. As difficulties finally became insuperable, I visited his typical localities in the expectation of getting information that would solve them. It was to my intense disappointment that I was forced to the conclusion that his divisions of the "system" were based upon what I considered to be incorrect observation of the field evidence.

P. MARSHALL.

Otago University, Dunedin, New Zealand.

PROF. MARSHALL'S clear statement of the palæontological difficulties in this case should stimulate the search for further fossiliferous horizons. The Ordovician and Gotlandian beds of the British Isles were laid down in many places "during the continuance of uniform physical conditions and in direct continuous succession"; none the less, two systems have been conveniently maintained. The unwieldy "Karroo system" of South Africa would no doubt be split up were marine representatives of its strata available close at hand.

G. A. J. C.

Dana's Proof of Darwin's Theory of Coral Reefs.

I THINK Mr. Crossland, in his letter to NATURE of April 3, is mistaken in assigning a fault origin to the narrow "khors" which form the harbours along the Rea Sea coast. I visited a number of these during a land journey from Halaib to Port Sudan in 1908, and although I had not much time for detailed investigation, I saw nothing which pointed to any other origin than erosion and subsidence. The steep-sided character of the shallow valleys, which Mr. Crossland takes as indicative of a fault origin, is, I think, merely a consequence of the toughness of the coral-rock and the smallness of the rainfall in these regions. It is a character common to many inland "wadis" where there is no suspicion of rift action.

The occurrence of coral-reef coverings on the coast-hills is, of course, a proof of elevation of the land; but on what does Mr. Crossland base his conclusion that the elevation has been *continuous?* Has any systematic slickensiding or brecciation of the rocks, such as usually accompanies a fault, been observed along the sides of the valleys? Or has it been proved that the floors of the valleys consist of the same beds as occur at higher levels on either side?

Like Mr. Crossland, I write from the wilderness, and cannot now refer to the papers which he cites. But as an admirer of the devotion and skill with which Mr. Crossland has pursued his important biological researches on that desolate shore, I read his two last papers very carefully at the time of their publication. If my memory is correct, the papers contain no real evidence as to a fault-origin for the "khors." Rather does Mr. Crossland seem to take faulting for granted, and then to adopt it as the explanation for all the topographical features of the coast, even going so far as to regard Ras Raweiya as a piece torn from the mainland and shifted several miles out to sea—a view in which I imagine few geologists will agree.

Unless further facts can be adduced, I think the "khors" of the Red Sea coast are most reasonably explained as valleys which were eroded by streams when the land was at a greater elevation than it is now, and have since been submerged by subsidence.

JOHN BALL.

Wadi Baba, Sinai, April 20.

Sub-Red Crag Flint Implements and the Ipswich Skeleton.

I NOTICE that NATURE of May 8 contains an account of a paper read by Mr. W. H. Sutcliffe before the Manchester Literary and Philosophical Society, in which he refers to the sub-Red Crag flint implements and the pre-Chalky Boulder Clay human skeleton I have discovered.

Mr. Sutcliffe argues that because the rostro-carinate flints are found below the Red Crag, and (as he asserts) in the Palæolithic gravel of Hackney Downs, they cannot be of human origin, because it is "inconceivable that a human production should have retained exactly the same form throughout this immense period."

Apart from the fact that the rostro-carinate specimens have *not* retained exactly the same form during the periods in which they were used, it appears to have escaped Mr. Sutcliffe's notice that a river-gravel is composed of material of the most varied ages, and that therefore the examples of this type found in the Hackney Downs deposit need not necessarily be of Palæolithic age.

But even if they do belong to this period that has no bearing upon their "humanity"—the ordinary round-ended scraper was made in the most remote times, and is still used by the present-day Eskimo. Mr. Sutcliffe has also apparently "found" that the rostro-carinate flints are "not adapted to any likely use," and cannot therefore be held to afford good evidence of Pliocene

This is a very shaky and unsound objection, as it is open to anyone to "find" that the ordinary Palæolithic implement is practically useless, and therefore non-human.

Mr. Sutcliffe has evidently not carefully read the published accounts of the evidence in favour of the high antiquity of the Ipswich man. It has never been suggested that the skeleton was lying *on* a land surface of loose sand, and exposed to the direct action of moving ice, but that the bones had probably either been buried in that surface or covered by blown sand to a considerable depth.

If Mr. Sutcliffe had examined the evidence I have mentioned with an open and unbiassed mind, he would have recognised that the actual provenance of the Ipswich bones is as well established as any prehistoric skeleton yet unearthed.

J. REID MOIR.

Openings Required for Laboratory Assistants.

You have in the past been kind enough to insert a letter of mine with regard to the London County Council laboratory monitors, whose services the council is unable to retain after the age of seventeen, and whom it has requested this association to place in

work. Thanks to the publicity which was given by NATURE to the needs of these young men, I was able to place a certain number of them in good commercial laboratories, and it is satisfactory to know that in nearly all cases they have justified my opinion of them and are doing well. More than thirty have been placed during the past three years, and are under my supervision still.

The council has recently referred to me a large number of these lads who are shortly leaving its service, and I should be glad to be permitted to make this fact known among readers of NATURE, as I am confident that should any employers desire promising assistants for their laboratories they would be able to obtain satisfactory applicants through this source. Applications should be made to the hon. secretary, Apprenticeship and Skilled Employment Association, 61 Denison House, 296 Vauxhall Bridge Road, S.W.

G. E. REISS,
Hon. Secretary.

May 14.

The Use of Spectacles with Optical Instruments.

WITH reference to the inquiry in NATURE of May 1 (p. 215), the general rule in cases where a person using spectacles wishes to use an optical instrument is, that for telescopes and instruments used for distant objects, use the distance correction; for microscopes and instruments for near work, the near correction should be worn. Care should always be taken to use the centre of the spectacle lens. If no astigmatism is present there is generally sufficient focussing room to enable the observer to dispense with the spectacles. The most comfortable method is to have a cap made for the eyepiece of the instrument with a lens equivalent to that in the spectacle. This should be set as close to the eye-lens as possible, and in cases of astigmatism they should be marked so that the axis may be correctly set. Any good optician will do this at small expense.

HERBERT S. RYLAND.

9 Alwyne Square, Canonbury Park, N., May 14.

NATURAL HISTORY AND SPORT.[1]

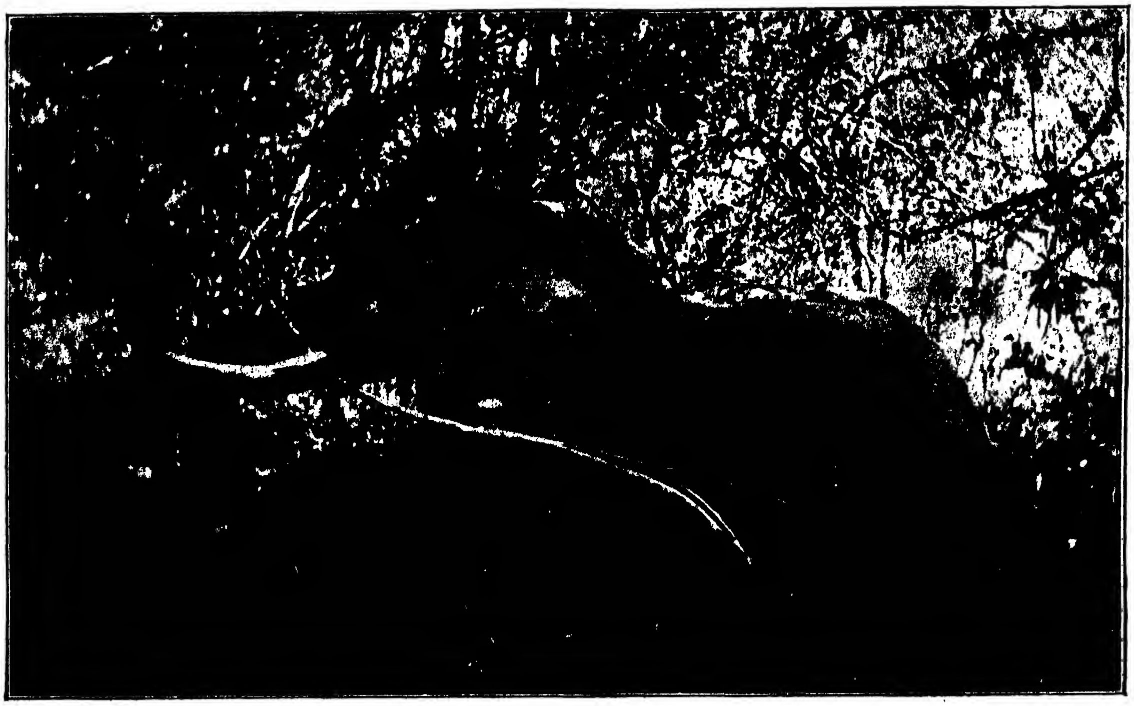
(1) IT is now six years since the publication of Captain Shelley's great monograph of the birds of Africa was suspended by the illness that overtook and ultimately proved fatal to the author. Fears, however, that the work might remain unfinished were happily allayed by the announcement that Mr. W. L. Sclater had undertaken to carry it on to completion. Several years elapsed before the final arrangement could be made, and it was not until 1912 that Mr. Sclater was able to bring out the volume under notice, which deals with the Lanii or drongos and shrikes, and is the second part of the fifth volume. This part is in every way up to the standard of its predecessor, and shows that Captain Shelley could not have committed the task to more competent hands than those of Mr. Sclater, who has a genius for systematic ornithology. The book would certainly have been improved and its cost not greatly increased by the addition of a few outline figures in the text to illustrate some of the structural characters of the birds; but the eight coloured plates drawn by that competent draughtsman and greatly improved bird-artist Mr. A. Grönvold are excellent. Apart from the systematic descriptions and the useful analytical identification keys, a full account of the known distribution of every species is given, and its habits, where observed, have been duly recorded.

(2) As director of the museum at Port Elizabeth, Mr. F. W. Fitzsimons has had exceptional opportunities of studying the snakes of South Africa, and his volume is the outcome of observations, extending over many years, upon these reptiles both in their native haunts and in captivity; and, thanks to his freedom from the restrictions imposed in some other countries, he has been able to make a long series of experiments upon the venom of the poisonous species. These experiments have shown, amongst other things, that none of the snake-killing mammals and birds of South Africa, like the mongooses, zorillas, hedgehogs, and secretary birds, is immune against snake venom, as has been stated and is often believed, but that one and all owe their ability to escape from and overcome even such redoubtable antagonists as the puff-adder and yellow cobra either to their extreme quickness in warding off or avoiding the stroke or to their protective armature. The experiments have also convinced Mr. Fitzsimons that the antivenene recommended by Dr. Martin and Major Lamb "by no means possesses the high standard of venom-killing power some people claim for it." These are only samples of the interesting matter contained in the volume, which is a medley of varied information, anecdotes relating to habits and field experiences being sandwiched between technical diagnoses of genera and species, often taken verbatim from the British Museum catalogue, the whole subject-matter being presented in such a manner as to make a volume both useful to the specialist and readable to the ordinary layman.

(3) The tale of Mr. Sutherland's ten years' adventures as an elephant-hunter in Portuguese and German East Africa is told with a simple charm and ease of style which give his volume a foremost place amongst books of African sport; and the interest of his experiences, some of them unique and most of them exciting, is heightened by the knowledge that he met them single-handed, with only one or two trusted natives to act as trackers and carriers. So vividly are the scenes depicted that on regretfully turning the last page one cannot but echo the sentiment of the author when he writes: "After so many years of a wild, free life, I find it difficult to accommodate myself to the stuffiness and constraint of a modern city; I prefer the forest to the imprisonment of streets, the twinkling stars to lamps, the sigh of the primitive forest to the tramp of thousands of human feet."

[1] (1) "The Birds of Africa." Comprising all the Species which occur in the Ethiopian Region. By P. E. Shelley. Vol. v., part ii., completed and edited by W. L. Sclater. Pp. viii+165–502. (London: H. Sotheran and Co., 1912.) Price 1s 6d net.
(2) "The Snakes of South Africa" Their Venom and the Treatment of Snake Bite. By F. W. Fitzsimons. New edition. Pp. xvi+547. (Cape Town and Pretoria T. Maskew Miller; London: Longmans, Green and Co., 1912.) Price 12s. 6d
(3) "The Adventures of an Elephant Hunter." By J. Sutherland. Pp. xix+324. (London: Macmillan and Co., Ltd., 1912.) Price 7s. 6d. net.
(4) "Baby Birds at Home." By R. Kearton. Pp. xv+128. (London: Cassell and Co., Ltd., 1912.) Price 6s.

From repeated encounters with African big game of all kinds, Mr. Sutherland concludes that the pursuit of the elephant is beyond doubt the most dangerous. Next come buffaloes and lions, which are about on a par; but it will surprise many of his readers to learn that the risk in shooting rhinoceroses is very small, smaller indeed than that attending the shooting of leopards. The volume is not, however, devoted wholly to sport. It contains much valuable information about the superstitions and social organisation of the natives, as well as harrowing descriptions of intertribal raids, throwing a lurid light on the life of uncivilised man.



Kom-Kom: the terror of Nagoromenia's kraal. From "The Adventures of an Elephant Hunter."

(4) "Baby Birds at Home" is a book for children. It is written in suitable style, but its chief merit is perhaps the excellence of the photographs with which it is illustrated. R. I. P.

THE PRODUCTION OF APPARENT RELIEF BY "KINOPLASTIKON."

AT the Scala Theatre—the home of "Kinemacolor"—there is now being exhibited a new feature, termed "Kinoplastikon," which is advertised as "singing, talking, moving, picture figures without a screen," and has been described in notices in the daily Press as stereoscopic. We visited the theatre recently in order to see this display and discover, if possible, how the stereoscopic effect was produced. We hoped to see some new optical principle illustrated, but in this we were disappointed.

After a number of the now well-known colour films had been exhibited there was a short interval, and then the curtain drew up, showing the stage set as an ancient temple, with two rows of columns and a background. This was all decorated in quiet colours such as brown and terracotta, and was only feebly lighted. Two attendants brought on a pair of tables, set them between the back pair of pillars and retired. Then two somewhat ghostly pierrots, dressed in white, appeared to come on the stage, and to play a xylophone duet on instruments on the tables. A gramophone produced the music and kept time with the movement of the players.

The optical effect appears to be produced by a variation of the old "Pepper's Ghost." A huge sheet of plate-glass—it must be 20 to 30 ft. square—seems to be set up in a vertical plane, making an angle of 45° with the front of the stage, so that any brightly lighted object on the left of the stage, as seen from the auditorium, may be seen by the audience by reflection as if it were upon the stage itself. A diagram will make the arrangement clearer. MN is the front of the stage, AB the background. CD, EF, GH, the pillars of the temple. GL is the sheet of glass. Then a bright object at PQ will be seen by the audience at XYZ as though it were at P′Q′.

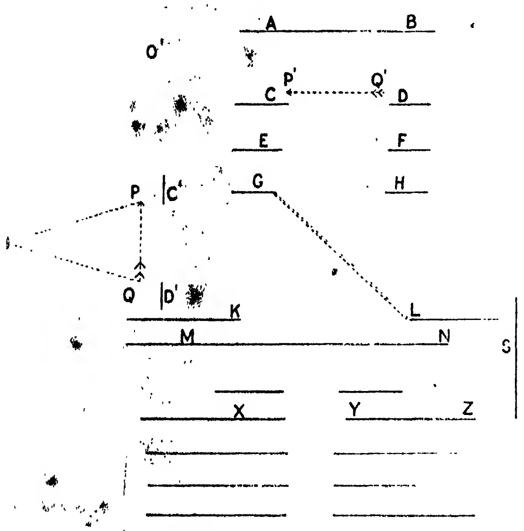
The figures are apparently projected by an animatograph O upon a semi-transparent screen at PQ.[1] Stray light from the lantern coming through the screen could be seen shining

[1] In order to avoid the great length from O to the centre of the stage, it is probable that the lantern is placed to shine down from above, or up from below, or even forwards from O′, a silvered mirror reflecting the light into the required direction.

on the theatre wall at S. As only the figures themselves were seen, the rest of the screen must have been dark, and therefore the background of each picture must have been painted out on the film with black (unless the film was unusually opaque). This painting out would account for the absence of the "rain" effect of the usual animatograph reproduction.

It is obvious from the foregoing that there is no stereoscopic effect in the strict sense, *i.e.* that there is no difference between the picture seen by the right eye and that seen by the left eye, at least so far as the figures are concerned. But as the picture is a long way back on the stage (some 40 ft. or more), so that the difference between the pictures that should be seen by the two eyes would be quite small, and as the temple itself is of course in relief, there is no difficulty in imagining the figures to be in relief also; indeed, as they step backwards and forwards the illusion is very complete.

Some parts of the glass were unfortunately



badly out of parallelism, and when the reflection occurred at these places a doubling of the image was produced, which made the figures very indistinct; this, of course, cannot be avoided in such a large sheet of glass. Some other defects that we noticed could have been avoided. For instance, the image of the edge of the screen PQ did not quite coincide with the pillars CD; so that when the figures walked off the stage they disappeared before they reached the pillars. Apparently the image P′Q′ is a little behind the plane CD (for this defect was more evident at X than Z); if so, a pair of pillars C′D′ should be so placed in front of PQ as to form an image exactly coincident with CD. Then, wherever the image was viewed from, this parallax would disappear. We also noticed that the barrel in one item, which was placed on the stage, was not quite the shape or size of the one in the picture. The upper part of a pillar at B was rather brighter than the rest of the background, and could occasionally be seen through the figures. It should be painted a little darker.

ERADICATION OF PLANT DISEASES.

THE general assembly of the International Institute of Agriculture in session at Rome has wisely refrained from extending the Phylloxera Convention to all cases of plant diseases. Signor Cuboni's report on the diseases of plants and the best method to prevent their propagation gave rise to a lively discussion, but it was felt that rough-and-ready measures would do more harm than good. Ultimately a memorandum was adopted conveying the following recommendations:—

(1) The establishment of a Government service of phytopathology by all Governments of countries adhering to the International Institute of Agriculture.

(2) The convening at an early date of an international conference of specialists with the view of arriving at an international agreement upon the means of preventing plant diseases. The wish was expressed that the French Government would follow up the initiative it has already taken by calling such a meeting.

(3) At each general assembly of the institute the specialists of the various Governments should meet in a separate commission to discuss the results of their researches and studies on the diseases of plants.

(4) Countries adhering to the International Institute should at once begin to study the various questions which the International Commission of Phytopathology will have before it, basing their study upon the materials which the International Institute of Agriculture will be able to furnish.

The subject is one for concerted action. The study of plant diseases is not a simple one. It concerns the entomologist and protozoologist as well as the botanist, and among botanists not merely the students of fungi or bacteria, but the physiologist and the investigator on Mendelian lines; for the production of disease-resisting forms is one of the surest ways of eliminating the disease-factor. Furthermore, periodical meetings of the workers in these various fields of investigation will tend to encourage the worker, and will ensure that the results of the work are put to the best advantage. Comparison of results obtained in the same line of research under the various conditions offered by different countries will be specially helpful; and if international legislation is to follow, these various conditions must be carefully considered.

It should be obvious also that an organised service of phytopathology is an essential, and an *ad hoc* training of experts is a prime necessity. The study of plant diseases offers ample scope for investigation, and a Government service would find work for a supply of experts at home and abroad. One example will suffice. The Jamaica banana industry has been recently threatened with disaster because the Department of Agriculture had no expert in plant diseases to recognise on its outbreak a well-known disease which had already caused serious loss to the same industry in Central America.

NOTES.

At a meeting on Monday, May 19, the council of the Royal Society of Arts passed the following resolution:—"On the occasion of the fiftieth award of the Albert medal of the Royal Society of Arts, the council of the society desire to offer the medal to H.M. King George V., for nine years president, and now patron of the society, in respectful recognition of his Majesty's untiring efforts to make himself personally acquainted with the social and economic condition of the various parts of his dominions, and to promote the progress of arts, manufactures, and commerce in the United Kingdom and throughout the British Empire." The Albert medal was established in 1862 as a memorial of H.R.H. the Prince Consort, who had been president of the society for eighteen years. It is awarded annually for "distinguished merit in promoting arts, manufactures, or commerce." In 1887 it was awarded to Queen Victoria on the occasion of her jubilee, and in 1901 to King Edward VII., when, on his accession to the throne, he relinquished the presidency of the Society of Arts, which he had held for thirty-eight years.

Mr. Edwin Tate has just made a donation of 10,000*l*. to the Imperial Cancer Research Fund, for the endowment of the research.

Mr. H. H. Law has been appointed chief engineering inspector to the Local Government Board, in succession to Mr. G. W. Willcocks, C.B., retired.

The King has appointed Commander E. R. G. R. Evans, R.N., a Companion of the Order of the Bath (C.B.), in recognition of his services with the British Antarctic Expedition, 1910–12.

Prof. Bateson's postponed lectures on the heredity of sex and some cognate problems will be delivered at the Royal Institution on Monday, June 2, and Wednesday, June 4, at three o'clock.

The Berlin correspondent of *The Times* announces that Prof. H. Weber, professor of mathematics at Strassburg University since 1894, died on May 17 at seventy-one years of age.

We learn with regret that Dr. Lester F. Ward, professor of sociology at Brown University, Providence, R.I., and formerly palæontologist of the U.S. Geological Survey, died in Washington on April 18, in his seventy-second year.

The fifty-eighth general meeting of the Institution of Mining Engineers will be held on Thursday, June 5, at 11 a.m., in the rooms of the Geological Society, Burlington House, Piccadilly, London, W. The institution dinner will be held at the Waldorf Hotel on the evening of the same day.

We learn from *Science* that a tablet in honour of Dr. S. P. Langley was unveiled in the Smithsonian Institution on May 6. Addresses were delivered by Dr. Alexander Graham Bell and Dr. J. A. Brashear. At the same time Langley medals were awarded to M. Gustave Eiffel and Mr. Glenn H. Curtiss. Later in the day the Aëro Club of Washington arranged an aviation display in the grounds of the Army War College in honour of Dr. Langley.

The Paris correspondent of *The Times* announces the death of M. Alfred de Foville, perpetual secretary of the Académie des Sciences Morales et Politiques. M. de Foville, who was in his seventy-second year, was one of the most eminent political economists and statisticians of his day. From 1877 to 1893 he was chief of the Department of Statistics and of Legislation in the Ministry of Finance, and for a time he concurrently occupied the chair of industrial economy and of statistics at the Conservatoire des Arts et Métiers.

An influential international committee has been formed to endeavour to establish a uniform notation in the theories of potential and elasticity. The committee has already sent out a circular to all those likely to be interested in the subject asking what are the notions and notations with respect to which uniformity is desirable. Discussions on the subject will be arranged to take place at the international congresses of mathematicians in 1916 and 1920, and it is hoped that the final report of the committee will be issued in 1921.

The series of British land and fresh-water shells in the British Museum (Natural History) has received an important addition in the shape of a large collection brought together by Mr. F. H. Sikes, of Burnham Abbey, Burnham, Bucks, who has presented it to the nation, on condition that it shall be exhibited in the public galleries. The collection includes specimens from the cabinets of Messrs. Cairns, Fitzgerald, Grateloup, and Rogers, and is reported to be of special value on account of the care with which the less common species and subspecies have been named. The collection has already been received at the museum.

A message from the Paris correspondent of *The Times* states that the Congress of the Royal Institute of Public Health was opened on May 16 at the Sorbonne in the presence of a number of eminent French and English men of science. The Under-Secretary of State for the Interior, M. Paul Morel, welcomed the members of the congress to Paris on behalf of the Government. Prof. W. R. Smith said, in reply, that the holding of the congress in Paris was a further proof of the closeness of the relations existing between the country of Lister and the country of Pasteur. Speeches were also made by Prof. Landouzy, president of the French section of the congress, Sir Thomas Oliver, who is president of the industrial section, and the Lord Provost of Glasgow. At the close of the meeting Prof. Smith handed to Prof. Roux, director of the Pasteur Institute, the gold medal of the Royal Institute of Public Health.

An impressive collection of photographs of scenes connected with Capt. Scott's ill-fated Antarctic expedition is reproduced in yesterday's *Daily Mirror*, May 21. The pictures include a striking view of the cairn, surmounted by a cross, erected over the tent where the bodies of Capt. Scott, Dr. Wilson, and Lieut. Bowers were found; photographs of the explorers on skis dragging their sleigh towards the south pole, and standing near Amundsen's tent, which they found upon arriving at their goal; the last photograph of the party of five taken at the pole; and the tent in

which Capt. Scott and his two companions waited until the icy hand of death relieved their sufferings. When the search party found the tent, it was nearly buried in snow, and in a few months all trace of it would have disappeared. All the illustrations are remarkably fine, and they serve to show the nature of the region near the south pole, as well as to stimulate pride in human endeavour.

CAPT. J. K. DAVIS, commander of the *Aurora*, the vessel attached to Dr. Mawson's Australasian Antarctic Expedition, reports the results of his endeavours to relieve the two parties in January and February of this year. He had already visited the main party, and taken part in the search for Dr. Mawson himself and his two companions, Ninnis and Mertz, whose tragic loss has already been reported. Prevented by bad weather from taking off this party, Capt. Davis was forced to leave them in order to hurry to the relief of the other, under Mr. F. Wild, 1500 miles westward of Commonwealth Bay. These men were found all well, and were taken off just in time to escape the closing ice, though the ship did not escape very severe weather on the return to Hobart. Some anxiety must be felt for the main party: Dr. Mawson himself, by travelling alone for twenty-two days, bereft of his two companions, has undergone an experience scarcely less terrible than that of any of his predecessors in polar exploration, but the base is well equipped. The wireless telegraphic station on Macquarie Island maintains communication between the base and Australia, and is signalling daily weather reports, while among other scientific work, sufficient soundings for a section of the ocean bottom between Hobart and the Antarctic are mentioned by Capt. Davis. He himself is visiting England with the especial and laudable purpose of raising funds to aid the cost of the prolonged stay of the main party in the south polar region.

THE President of the Local Government Board has authorised the following special researches to be paid for out of the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease:—The causes of premature arterial degeneration, Dr. F. W. Andrewes; insects in relation to disease (Prof. Nuttall, F.R.S., on the life-cycle of the body louse and bug; Dr. Bernstein and Mr. Hesse on the *Empusa muscae* in flies); infantile diarrhœa, Mr. F. W. Twort and Dr. Edward Mellanby; the virus of poliomyelitis, Drs. Andrewes and M. H. Gordon; the character and life-history of certain filter-passing micro-organisms, Mr. F. W. Twort; respiratory exchange in man under varying conditions, Prof. Leonard Hill, F.R.S.; the biochemistry of syphilis, Mr. J. E. R. McDonagh; the possibilities of serological diagnosis of scarlet fever, Dr. L. Rajchman; the relation between the clinical symptoms and the bacteriology of the acute respiratory affections, Dr. D. M. Alexander.

A CABLEGRAM has been received at Bishop's Stortford from Bangalore, announcing the death, from snakebite, at the early age of thirty-seven, of Mr. Herbert Kelsall Slater, geologist to the Mysore Government. Mr. Slater was educated at Bishop's Stortford College, which he left in 1894. After spending the next seven years at Bangalore with his father, the Rev. T. E. Slater, he was sent in 1901 to the Royal School of Mines, where he studied geology under Prof. Judd. On the recommendation of Mr. Foote, he was appointed in 1902 geologist to the Mysore Government, for which he did much valuable work. The results of his work are given in the records of the Mysore Geological Department (see NATURE, vol. lxxviii., p. 470). He surveyed and mapped large districts, and among important ores which he found to be widely distributed are gold and manganese ores. He also discovered and described important felsite and porphyry dykes; and the palace of the Maharaja is built from stone discovered by him. He spent December to May each year in prospecting, and it was while camping on one of these expeditions in the district of Shimoga that he met with the accident that caused his death. Not long ago Mr. Slater spent about six months in a tour in Canada in order to gain additional light upon his sphere of work in India by the study in the field of great Archæan complex.

THE work of the British School of Archæology in Egypt this winter, under the personal direction of Prof. Flinders Petrie, has been attended with some interesting results. At the close of the last season's work a first dynasty cemetery had been partly excavated at Tarkhan, about forty miles south of Cairo, and this year the site has been systematically worked; eight hundred graves, grouped on each side of an axial road, have been carefully cleared and studied, and much pottery and strings of carnelian, garnet, and blue-glazed beads have been recovered. The damp of the valley in which the cemetery lies has prevented the removal of the bones, but these were all carefully measured, and some seventy of the skulls, preserved by solidifying with paraffin wax, will be brought to England for further study. The new material thus obtained will be a valuable supplement to the careful and exhaustive collections made by the American excavator, Prof. Reisner, mainly in Upper Egypt, and published, with Prof. Elliot Smith's collaboration, two or three years ago. Meanwhile the excavators interpret the new evidence as proving the existence at Tarkhan of the conquering tribe of the dynastic people of ancient Egypt, who had advanced northward from Abydos, subduing the Nile Valley, until Mena founded the new capital of United Egypt at Memphis. It is interesting to note that, according to the discoverers, the men of the dynastic race were an inch or two shorter than the indigenous population; and this supports the persistent native tradition that the conquerors owed their success to superiority in armament rather than in physical qualities. At Gerzeh, another site a few miles further south, some interesting finds were also made, dating from the twelfth and eighteenth dynasties, the most remarkable being a gold pectoral inlaid with coloured stones, like the celebrated Dahshur jewellery.

MR. E. W. DEMING gives, in *The American Museum Journal* for March, an interesting account of the scheme now being undertaken to prepare, on the walls

of the museum, a series of panels illustrating the life of the American Indians. Each panel will tell the story of the life of a particular stock—their mode of living, customs, decoration of their lodges, life in the tipi, transportation, in short, all the minor details which will give colour and reality. The general control of the work rests with Mr. Deming, who has lived for some fifty years with various Indian tribes. He will utilise the material collected by Mr. Louis Akin, a skilled painter, who was received as a member by the Hopi tribe, and unfortunately died at Flagstaff, Arizona, in January last. His untimely death, at the age of forty-five, is a serious loss to American art and anthropology.

The National Geographic Magazine for March publishes an article by the late American Minister to Guatemala, Mr. W. F. Sands, on the prehistoric ruins of that country. This is the preface to an account by Mr. S. G. Morley, assistant director of the Quiriqua Expedition of 1912, of the excavations at this place, situated fifty-seven miles from the Caribbean Sea. It was one of the early centres of the Maya civilisation, which flourished in south Mexico, Guatemala, and North Honduras during the first fifteen centuries of the Christian era. The place was unknown since Hernando Cortez passed within a few miles of it in 1525. A series of temples has now been disinterred containing many interesting carvings and hieroglyphs, the interpretation of which is still, in a great measure, unknown. So far the excavations are merely tentative. But the School of American Archæology proposes to pursue the work, which cannot fail to throw much new light on the problems of Maya culture.

THE Palæolithic skull from Piltdown, Fletching, Sussex, just described in the Quart. Journ. Geol. Soc. by Dr. A. Smith Woodward as the type of a new genus and species (*Eoanthropus dawsoni*), has been placed on exhibition in a special case in the central hall of the Natural History Museum.

ACCORDING to the report for 1912, work at the Sarawak Museum has been somewhat interrupted by the absence on leave of the curator; it is hoped, however, that this will be more than compensated by the information acquired during his visit to Europe. A strenuous effort is being made to place on exhibition a mounted series of the local birds.

IN the May issue of *The Selborne Magazine* it is announced that the Selborne Society now possesses no fewer than ninety-five editions of Gilbert White's "Natural History of Selborne," and even this is believed not to exhaust the list. On another page Mr. Rashley Holt-White writes to express his belief that the print recently declared to be a portrait of the Selborne naturalist is not correctly identified.

THE recently published report of the advisory committee for the Tropical Diseases Research Fund for 1912 shows, as usual, great activity in research in the schools, universities, and laboratories at home and in the Colonies, supported by pecuniary contributions which can scarcely be considered creditable to a great Empire. The total revenue of the fund for 1912 was 3425*l*.; the expenditure was 3833*l*. 6*s*. 8*d*. The excess of expenditure over income was met by drawing on the accumulated balance of the fund, and it was necessary to warn the schools of tropical medicine that it would not be possible to repeat in 1913 grants on the same scale. Appended to the report of the committee are those of the professor of protozoology in the University of London, the Quick Laboratory, Cambridge, the London and Liverpool Schools of Tropical Medicine, and of several Colonial laboratories. As usual, these reports describe many important investigations, especially in the transmission of parasites and the causation of disease, which it is to be hoped will find their way also into the ordinary channels of scientific publication, where they will be less likely to be overlooked.

IN *The New Phytologist* for February (vol. xii., No. 2), Mr. H. Takeda gives an interesting general account of the vegetation of Japan, which has also been issued as a reprint (Wesley and Son, London, price 1*s*., post free). The author describes the geographical features and climate of Japan, laying special stress on the influence of the warm and cold currents which wash the shores of the long chain of islands composing the Japanese Empire, and exert a marked influence upon the vegetation, as well as on the great variety of climatic conditions which obtain owing to the fact that the islands extend over thirty degrees of latitude —the southernmost islands being subtropical, while the most northerly have a climate like that of Nova Scotia or Iceland, the harbours being blocked by drifting ice from November to April. He then describes the various plant formations occurring in the northern, middle, and southern regions, into which, for convenience, the country is divided from the phytogeographical point of view, with numerous examples illustrating the range from arctic through subarctic, cold temperate, warm temperate and subtropical to tropical types of vegetation. The vertical zonation of the vegetation on the higher mountains is illustrated by a description of the plant communities seen on ascending Mount Fuji. The paper also contains a discussion of the origin and affinities of the Japanese flora, and short accounts of the cultivated crops and of the introduced and garden plants.

A PAPER recently presented to the Royal Geographical Society by Lieut. H. A. Edwards gave a very clear idea of the important character of the survey work of the commission on the northern boundary between Bolivia and Brazil, in 1911 and 1912. The work is to be continued, but already a considerable area, previously unmapped and practically unknown, has been covered between the sources of the Bahia and Rapirran rivers. In 1911 a primary station was established on the latter river, which was then followed and mapped up to its source, after which the British commissioners, without their Brazilian colleagues, crossed the watershed to the valleys of the Abuna and Xipamanu. In 1912 the boundary line following the River Acre was mapped from Cobija to Tacna, and a party crossed to the Bahia, and thence to the confluence of the Ina and Xipamanu, from which point the Riparran was again visited, and a junction effected with the starting

point of the work of the preceding year. A general description of the country, with facts concerning its geology, climate, flora, and fauna, was furnished by Lieut. Edwards, and some idea as to the extreme difficulties attendant upon exploration, and particularly upon careful survey, in this region, was afforded by his account. Progress, whether along the rivers or through the forests, meets with continual opposition from nature in one form or another; insect-pests attack the travellers and their animals, and food supplies are often far from easy to keep up.

THE measurements made last year by Prof. McClelland and Mr. Kennedy of the number and mobility of the large ions present in the atmosphere cast some doubt on the generally accepted interpretation of the records of the various types of instruments intended to measure the ionisation in the atmosphere at any time. The number of small ions of mobility about 1·6 cm. per second in a field of 1 volt per cm. may be taken as 1500 per c.c. in normal circumstances, while the authors find that the air of Dublin has in it about ten times as many large ions of mobilities of the order of 1/3000 cm. per second. There is strong evidence that they consist of a nucleus, originally uncharged, which attracts to itself one of the small, more mobile ions. The nucleus itself probably consists of an invisible drop of water, which it is known may exist in air even when the air is unsaturated. Further investigation is, however, necessary before the absence of ions of intermediate sizes can be satisfactorily accounted for. The description of the methods of measurement adopted will be found in the December, 1912, number of the Proceedings of the Royal Irish Academy.

IN No. 15 of the *Revue Scientifique* is published an address delivered by Prof. Victor Grignard on the occasion of the presentation to him at Stockholm of the Nobel prize. In this address he gives a brief summary of the different types of synthesis by means of magnesium, with which his name is associated, and which have led to extremely fruitful developments in the domain of organic chemistry. During the past ten years no fewer than seven hundred papers have appeared dealing with the "Grignard reaction," whilst in practice it has found important application in the commercial synthesis of such drugs as stovaine and alypine, which have many advantages over cocaine and of many compounds of importance in perfumery.

WE have received from the Agricultural Experiment Stations of the Louisiana State University a copy of Technical Bulletin No. 135, which contains a report of investigations carried out by Dr. W. E. Cross and others on methods of analysis of sugar-cane products. The report includes a number of papers, of which the following are the most important:—The determination of dry substance by means of the refractometer; the application of dry basic lead acetate defecation to sugar-house analysis; a rapid method for the estimation of glucose in juices; a modification of the Clerget method of determining glucose in molasses; the effect of urea and betaine on the rate of inversion of cane-sugar by hydrochloric acid; and the direct estimation of cane-sugar in presence of reducing sugars. Useful tables are appended to the report.

IN the current number of the *Comptes rendus* (May 13) Ph. Barbier and R. Locquin give a new method for stepping down the series of the fatty acids. Starting with the acid $R.CH_2.CO.OH$, they convert this into the methyl (or ethyl) ester, and treat this with two molecules of magnesium methyl iodide, forming the tertiary alcohol $R.CH_2.C(OH)(CH_3)_2$. This, or the hydrocarbon $R.CH=.C(CH_3)_2$ formed by dehydration, on oxidation with chromic acid, gives acetone and the acid $R.CO_2H$, the next lower homologue of $R.CH_2.CO_2H$. The ketone $R.CH_2.CO.CH_3$ may also be used as the starting point for the production of the same acid, $R.CO_2H$. The reaction is a general one, and can be applied with success to dibasic acids; thus β-methyladipic acid gives methylsuccinic acid.

A LECTURE on the economics of engineering, delivered by Major W. J. A. O'Meara, C.M.G., at Faraday House, on February 26, has reached us in the form of a reprint from *The Royal Engineering Journal* for April. It is an excellent thing that the application of the principles of economics to individual trades should be considered, and Major O'Meara has done well to choose that of engineering for his lecture, since it plays so important a part in the production of the national wealth. He confines himself largely to electrical engineering, and deals mainly with the efficiency of management and organisation. He also deals shortly with the question of markets, showing the special and peculiar conditions attaching to this branch of the industry, and just touches very briefly on one or two other points. The main question treated in his lecture is divided into three sections—organisation, management, and technical aspects—and each of them is considered in reference to the conditions which conduce to the maximum efficiency. The former, for instance, deals with the establishment of a "direct chain of command" among those responsible for the work, the proper choice of officers for the various departments, the proper subdivision of the work, to render possible among other things the easy ascertainment of the costs of each class of work. Technical aspects, again, include economy in materials, design, the operating of plant, and methods of execution, in connection with which the necessity of avoiding, so far as possible, the dismissal of skilled workmen is forcibly urged. Indeed, brief though it is, the paper is highly suggestive, and arouses the hope that in the future Major O'Meara will give us a full and detailed treatment on these lines of the whole engineering trade.

SOME novel towing tests conducted at the experimental tank in the Navy Yard at Washington form the subject of an illustrated article in *The Engineer* for May 16. The questions to be investigated were whether existing piers in the Hudson River should be lengthened to meet the demands of bigger liners, and also to settle the problem of granting renewed permission for the continuance of two temporary extensions of 100 ft. each beyond the pierhead line approved by the Secretary of War in 1897. These questions involved the reproduction in the tank of both shore lines of the Hudson River throughout the berthing section of the big Transatlantic steamers,

and the models towed represented those ships now in service as well as a yet unbuilt craft 1000 ft. long. Suction was investigated by means of floating models and submerged buoys. The movements of these during each run of the towed model were recorded by use of moving-picture cameras, so situated that every essential movement could be caught. An index finger moving over a dial on the towing carriage showed the position of the model at every instant. While the full results are not yet published, it may be noted that the Government authorities have again refused permission for the temporary pier extensions to be made permanent.

UNDER the title of "The Land of the Blue Poppy," the Cambridge University Press will shortly publish Mr. F. Kingdon Ward's record of his experiences and observations while engaged in plant-collecting in western China and south-eastern Tibet during the year 1911. The book is dedicated to the memory of the author's father, Prof. H. Marshall Ward.

MESSRS. WITHERBY AND CO. have been appointed European agents for *The Emu*, the organ of the Royal Australasian Ornithologists' Union, and copies of that publication can now be obtained at 326 High Holborn, London, W.C.

OUR ASTRONOMICAL COLUMN.

COMET GALE (1912*a*).—An ephemeris for Gale's comet (1912*a*) is given in the *Astronomische Nachrichten*, No. 4651, by Herr M. Ebell, of Kiel, but the object is very dim, being fainter than magnitude twelve. It was observed on April 26 in Uccle by G. van Biesbroeck, and in Bothkamp by Dr. H. H. Kritzinger, and, according to the former, the ephemeris was in error by −3s. and +1·5′. Dr. Kritzinger describes the comet as an elliptical nebula 1′ and 0·7′ diameter, the brightness of the nucleus being 12·8 mag., the total brightness amounting to 12·5 mag. In answer to a telegram sent to Algiers, Herr F. Gonnessiat reports that on May 2 the comet was on the extreme limit of visibility.

The ephemeris up to the end of this month is as follows:—

	α true h. m. s.	δ true ° ′	Mag.
May 22	6 53 30	+45 44·5	
24	6 55 59	45 27·7	12·6
26	6 58 26	45 11·2	
28	7 0 53	44 55·1	
30	7 3 18	44 39·3	

THE SPECTRA OF SPIRAL NEBULÆ AND GLOBULAR STAR CLUSTERS.—Dr. E. A. Fath has been continuing his discussion of the spectra of spiral nebulæ and globular star clusters secured with spectroscopes attached to the 60-in. reflector of the Mount Wilson Observatory; his latest results appear in the April number of *The Astrophysical Journal* (vol. xxxvii., No. 3, p. 198). The spiral nebulæ here investigated are seven in number, the exposures ranging from 7h. 40m. to 38h. 14m., while the total exposures for each of the four clusters ranged from 13h. 5m. to 16h. 17m. In the case of the nebulæ they for the most part exhibit the spectra of solar type stars, but he refers to two, namely N.G.C. 1068 and 4736, as peculiar, giving evidence of "gaseous" radiation. Up to the present he has investigated altogether twelve globular clusters, and the result so far shows that as a whole the brighter stars of the globular clusters have spectra ranging only from the F- to the G-type. Dr. Fath hopes that as the clusters observed are nearly all readily reached in latitude 34° north, some southern observatory will undertake the investigation of those south of −20°, to find out whether they also exhibit this small range of spectral type so striking a feature of the northern clusters.

REPORTS ON INDIAN OBSERVATORIES.—Dr. G. T. Walker, the Director-General of Indian Observatories, has just forwarded his reports for 1912 on the observatories of Kodaikanal, Madras, Bombay, and Alibag, accompanied by the reports of the several directors. In the case of the first-named, he directs attention to the energies of Mr. Evershed, to the transfer of the Poona instruments to Kodaikanal, and to the appointment of Mr. Royds. He states that a serious effort is going to be made to teach the assistants to undertake the measuring of the numerous photographs, which up to the present has only been done by the gazetted officers. He hopes further to make the observatory an ordinary second-class instead of a first-class meteorological station in order to free the fourth assistant for solar work. The transit instrument at Madras in the beginning of 1910 suddenly changed its level, and the occurrence was repeated in 1911 and 1912. As this had never taken place before, it was thought that underground water currents had affected the earth neighbouring the concrete foundation. This is now going to be investigated, and in the meantime the Madras clock will be rated by wire from Kodaikanal. No special features are mentioned regarding the other two observatories, unless the reference to the absence of trouble from white ants at the Colaba Observatory be noted.

"L'ASTRONOMIE" FOR MAY.—The current number of the *Bulletin de la Société Astronomique de France* contains the address delivered by M. Camille Flammarion on the occasion of the twenty-seventh year of the existence of the French Astronomical Society. The subject of his discourse was confined to the progress of the society, and the success that the society has achieved is well known this side of the Channel. A very valuable feature in the journal is a series of reproductions of all the past presidents of the society. On the same occasion M. Puiseux summarised the advances made in solar studies during the past year, and this will be found useful to those not closely following the progress of solar physics. Other contents to which attention may be directed are "Les Photographies à poses variées," "Les Céphéides considérées comme Etoiles Doubles," "Comparaison d'un Chronomètre aux signaux rythmés," &c.

THE PARALLAX OF THE NEBULA G.C. 117 = N.G.C. 221.—Dr. Gustaf Strömberg communicates to *Astronomische Nachrichten*, No. 4650, his results of the determination of the parallax of the nebula G.C. 117, or N.G.C. 221, which he secured at the Stockholm Observatory. This nebula lies in the region of the Andromeda nebula, like a satellite to it, and is much easier to measure than the nucleus of the large nebula. The plates which Dr. Strömberg measured were those that were used by Prof. Karl Bohlin for his determination of the parallax of the Andromeda nebula. In his measures Dr. Strömberg employed a comparison star in the neighbourhood of the nebula, the coordinates being Neb. (G.C. 117) − ✱ : $\Delta\alpha = -11{\cdot}56$s., $\Delta\delta = -18{\cdot}3''$. The investigation embodied fifty determination of differences of R.A. and forty-six of differences of declination, and the parallax he secured was $+0{\cdot}073'' \pm 0{\cdot}055''$. Details of the research will be published later in the publications of the observatory.

TEACHING OF MATHEMATICS IN GERMANY.[1]

IN previous issues we have referred to papers on English education in mathematics which were laid before the 1912 International Conference on Mathematical Teaching. We have now before us, in five volumes, the German contribution to that conference. They give an account of mathematics at the primary and secondary schools, at the universities, in technical education, and in training colleges for teachers. They deal mainly with Prussia, but include also the non-Prussian parts of the German Empire, with an occasional reference to Austria.

Germany also has its reform movement in mathematics, and most of the changes that have been made lie to the credit of a body which bears the euphonious name of "der Damnu," into which its full title "Deutscher Ausschuss für den Mathematischen und Naturwissenschaftlichen Unterricht" has for the sake of brevity been telescoped. This body was formed in 1907, by the united action of a number of voluntary scientific associations, and is playing much the same part that the British Association committee has played in this country.

The aims and the present position of the movement are well illustrated by a scheme of teaching proposed by Dr. Schimmack for the Oberrealschule. The scheme covers the nine school years between the ages of nine and eighteen.

In geometry the scheme begins in the manner to which we are now accustomed in England, with measuring, drawing, practice with instruments, and work which familiarises geometrical concepts.

It is noticeable that there is two years' work in geometry before algebra is begun. This procedure, so excellent because of the more abstract and difficult nature of algebra, is not the result of the reform movement, but has long been the practice in Germany. It is a promising sign that the report of the curriculum committee of the Headmasters' Conference advocates this procedure, and gives us leave to hope that in this matter England will follow Germany's lead.

Algebra, then, is begun in the fourth school year, geometry having been begun in the second. It leads off well, with signless quantities, and it is rather pity that the subject is not carried on for a year or so with such quantities before the distinction between positive and negative quantities is introduced.

The trigonometry of right-angled triangles is to be introduced in the sixth year, as is also "projective geometry" (or cross-ratio geometry). The former proposal would find much support in this country; the value of the second item is not so clear.

In the seventh year the calculus is begun, differential and integral at the same time, a proposal which many in England will approve. Not so many will, however, approve of Dr. Schimmack's relegation of arithmetical and geometrical series to their proper place beside the calculus.

The scheme closes with "discussion of the foundations of geometry," too metaphysical perhaps for most boys; but we must remember that the scheme is intended for the Oberrealschule, and that less ambitious schemes would be appropriate to the Gymnasium and Realgymnasium.

An important note is appended to the scheme to say that throughout the course geometrical figures are to be thought of as variable and not rigid, and that attention is to be directed to the interdependence of the parts as the form of the figure changes.

The consideration of this scheme goes to justify our English reformers in their view that they are not sacrificing thoroughness to the desire to cover ground. It is much that the Germans, with their love of beginning from the very foundations, should declare for "functional thinking" from the start, for the introduction of trigonometry at fourteen or fifteen, and of the calculus at fifteen or sixteen, and should feel it possible to prune the course sufficiently to allow that.

The language of these volumes is at times curiously heavy. One happens on long, long sentences the meaning of which cannot be extracted by ordinary reading; they have to be logically dissected. And such sentences are frequent. Is the accusation true that command of language is spoilt by a mathematical training? Or have the Germans spoilt their language by the replacement of foreign words by sesquipedalian words of home manufacture? Whatever the cause, these volumes contain also the germs of better things. "Der Damnu" has been referred to. "Die Imuk" is a portmanteau word for die Internationale Mathematische UnterrichtsKommission, and "Der DATSCH" for der Deutsche Ausschuss für Technische SCHulen. Some extension of this idea will quickly reduce the most unwieldy sentence to manageable size.

[1] "Abhandlungen über den mathematischen Unterricht in Deutschland veranlasst durch die Internationale Mathematische Unterrichtskommission." In twenty-five parts. Herausgegeben von F. Klein. (Leipzig and Berlin: B. G. Teubner, 1909-12.)

"Berichte und Mitteilungen veranlasst durch die Internationale Mathematische Unterrichtskommission." In four parts. (Leipzig and Berlin: B. G. Teubner, 1910-12.)

THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

THE annual conference of the above association was held at Bradford during Whitsuntide. The address of the president of the association (Mr. P. Coleman, Northern Polytechnic, London) dealt mainly with the organisation of technical education, the value of "internal" examinations for technical students as compared with "external" examinations, and the London University Commission report in its bearing upon polytechnic work. He remarked in reference to this:—

"The report and the recommendations based thereon unfortunately show a bias that can only be due to a complete misconception of the work and standing of the London polytechnics. . . . The reasons given in the report appear to be based on insufficient evidence, and at variance with the facts as known to those who have a close acquaintance with the polytechnics."

Mr. Coleman urged the development of "non-vocational courses in the technical schools, partly because in many towns these schools are the only suitable institutions in which to hold such courses for adult students (whether technical students or not), and also in order to bring home to students whose main interest is necessarily the study of science or technology that "the work associated with their future occupation should not lead them to forget every other means of culture." As a practical measure in this direction, he suggested that the technical institutions "should definitely associate with themselves the University Extension Lectures of the locality, or such work as that of the Workers' Educational Association."

Papers were read to the conference upon vocational education, by Mr. Arthur C. Coffin, director of education, Bradford; co-ordination within a county area, by Mr. F. W. Cook, chief officer for technical education for the West Riding of Yorkshire; and the corporate life of technical institutions, by Mr. W. Hibbert, Regent Street Polytechnic, London. A number of sectional meetings were held, attended by teachers of special subjects, at which questions such as the qualifications for the registration of teachers, the syllabuses

and courses of work put forward by various examining authorities, and methods of teaching were discussed.

The principal resolutions passed by the conference dealt with the educational proposals of the Government, and the London University Commission Report. The conference urged the "necessity for improved provision for technical education and the organisation of technical education on a national basis." In addition, attention was directed "to the urgent necessity for increased grants from the State in aid of technical education," higher salaries for teachers to be a first charge upon these increased grants. With regard to the London University Commission report, a resolution was passed unanimously opposing any limitation of the existing facilities for obtaining external degrees, and the proposed exclusion of external students from the examinations in the faculty of technology, including engineering. This resolution also stated that many of the criticisms made in the report concerning London polytechnics and technical institutions are obviously founded on an incomplete knowledge of the work done in these institutions. The association strongly deprecated any weakening of the connection between these institutions and the University in view of the excellent results which have followed in the past as a result of the present relationships between the polytechnics and the University. The higher work in these institutions, whether day or evening, should form an integral part of the organisation of the faculties of science and technology.

A public meeting was held in connection with the conference in the large hall of the Bradford Technical College, the principal speaker being the Right Hon. J. A. Pease, M.P., the President of the Board of Education. During the course of his speech, Mr. Pease emphasised the importance of technical education, especially in the day-time if possible, and the necessity of "gradually bringing into the educational net nearly the whole of the population which left school between the ages of twelve and fourteen." New regulations would shortly be issued which, by means of larger grants and more elastic conditions, would favour the development of junior technical schools, "which would be linked up with the colleges and classes of a superior character." Mr. Pease criticised external examinations "as a waste of money and effort, and resulting in very little good." In concluding, he suggested that the key of the educational situation is to give more power, coupled with greater financial aid from the State, to the local authorities.

J. WILSON.

THE NATIONAL PHYSICAL LABORATORY.

THE annual meeting of the general board of the National Physical Laboratory was held recently at the rooms of the Royal Society, when the report and accounts for the year 1912 and the statement of work for 1913 were presented and approved for transmission to the president and council of the Royal Society.

In former years this meeting has usually been held at Teddington during the month of March, and has been combined with an inspection of the laboratory by the members of the board. In consequence of a change in the financial year, the annual inspection will in future be held at a later date. This year it is to take place on Thursday, June 26, when the Right Hon. A. J. Balfour will open the new buildings recently erected.

These buildings complete a scheme initiated in 1909 to provide laboratories for metallurgy and optics, with administrative offices, at an estimated cost of 30,000*l.*, exclusive of equipment; of this sum the Treasury undertook to provide 15,000*l.*, provided the remainder were forthcoming from other sources.

In 1910 the late Sir Julius Wernher generously provided 10,000*l.* for the erection of the metallurgy laboratory, and on learning lately that the actual cost had exceeded the sum available by 936*l.*, Lady Wernher most kindly defrayed the deficit.

To secure the further sum necessary for the completion of the scheme, and to obtain funds for the equipment of the buildings, an "Additional Funds Committee," of which the late Sir William White was chairman, was appointed during 1912. In its report this committee states that the Royal Commissioners for the Exhibition of 1851 had generously given a donation of 5000*l.* to the building fund, thus completing, with the gift from Sir Julius Wernher, the 15,000*l.* required to meet the Treasury grant.

Generous help towards the equipment has been received from many sources, including a number of the City companies. The committee, however, points out that considerable sums are still necessary to provide adequately the equipment which is essential for the proper development of the work.

The block of buildings for optics and administration is now nearly complete, and it is to open these that Mr. Balfour has promised to be present on June 26.

ATMOSPHERIC REFRACTION IRREGULARITIES.

THE anomalies of atmospheric refraction are numerous, and at various times irregularities extending over periods of one minute, one day, and one year have been discussed, that of the order of one second being generally known and causing "unsteady seeing." The variation of the order of one minute was discovered by Nusl and Fric experimentally in 1908, and they concluded that this irregularity had an amplitude of nearly a second of arc. The existence of such a large amplitude and its importance in meridional work suggested to Prof. Frank Schlesinger a redetermination by a perfectly independent method, and this he has done and described in a recent number of the Publications of the Allegheny Observatory (vol. iii., No. 1). He has based his measures on photographs of ordinary star trails made with the help of stationary long-focus instruments, and these he has had secured for him, according to a programme, by Prof. Slocum with the 40-in. Yerkes refractor, and Prof. Seares with the Mount Wilson 60-in. reflector, the star trails being those of the Pleiades group. The result deduced from the Yerkes plates, as is illustrated by curves in the publication, is to show the presence of this slow fluctuation, every one of the seven trails remaining at times above or below its mean position for a considerable fraction of a minute.

The same series of photographs was used to determine whether neighbouring stars showed the same fluctuations and whether the minor fluctuations were real. The curves plotted from these photographs thoroughly endorsed both these views, one figure showing the fluctuations of Merope and Alcyone as absolutely identical. To decide whether such one-minute fluctuations were common to mountain sites as well as low-lying situations, the Mount Wilson photographic trails were employed, and handled in the same way. The conclusion drawn was that the irregularities were of the same character, the amplitude being of the same order and the extreme range about one second of arc. Prof. Schlesinger thus directs attention to the fact that these results set a limit of accuracy to meridian work and show that photographic determinations of the distance between

two widely separated objects are much more accurate than micrometer (excluding double image or heliometer) observations with the same instrument, because the former are affected alike, the same time element being common to each.

PROPERTIES AND STRUCTURE OF ICE.

AN interesting account of a number of experiments by Prof. R. S. Tarr and Dr. J. L. Rich, of Cornell University, appears in the *Zeitschrift für Gletscherkunde* (Band vi., p. 225). The results agree mainly with those obtained by Mügge and MacConnell, and show that, as urged in 1869 by W. Mathews, those of Prof. Tyndall and Canon Moseley were inconclusive, through not taking sufficient account of the time-element in the problem. These recent experiments, which were both numerous and designed to test the various properties of ice, show that it welds readily at a temperature of 0° C.; that when a block of ice has been cut through by a wire and regelation has occurred, optical continuity is re-established, the new-forming crystals being controlled by those previously in existence, and that the welding, at temperatures well below the freezing point, to some extent resembles what has been observed in marble after being crushed.

The authors tentatively advance four propositions; the first, that the observed deformation is of the nature of plasticity, *i.e.* it is not initiated until a certain strain is reached, the plastic yield-point lying near the breaking point of the ice; the second, that the ease with which deformation may be produced varies with the direction in the crystal; the third, that the optical properties of a crystal are affected by such deformation, the effect being dependent upon the direction in the crystal in which the deformation takes place; and the fourth that granular ice, composed of interlocking crystals, is subject to deformation equally with a single ice-crystal. Pond-ice was mostly used in the experiments, but granular snow- and glacier-ice were also employed. The authors notice a suggestive fact in regard to the first, that in a cake 30 cm. thick, about 10 cm. at the top consisted of finely granular ice; the next 15 cm. of coarse prismatic crystals of ice, standing perpendicular to the water surface, and the remainder of finely granular ice with diversely oriented crystals.

THE WINDS IN THE FREE AIR.[1]

IT was noticed in very early times that the wind in the upper air may be very different from what it is on the surface. Lucretius says: "See you not too that clouds from contrary winds pass in contrary directions; the upper in contrary way to the lower." Bacon advocated the use of kites in studying the winds; but it is only in quite recent years that any systematic attempt has been made to investigate the free air above the surface of the earth. Kites have been flown to a height of four miles, but it matter of some delicacy to get even so high as two miles.

The temperature of the free air may be recorded by a meteorograph attached to a small rubber balloon, which continues to ascend until the pressure of the gas inside bursts the envelope, and the instrument descends again to the surface. The beautiful instrument constructed by Mr. W. H. Dines, F.R.S., the pioneer of upper air research in this country, is so light that the torn fabric of the balloon is sufficient to act as a parachute and check the speed of descent.

[1] Discourse delivered at the Royal Institution on Friday, April 11, by Mr. Charles J. P. Cave.

The general result of the observations has been to show that the temperature of the air decreases with height up to a certain point, above which the temperature distribution is nearly isothermal; however much higher the balloon may ascend, there is little further change of temperature. This upper layer, discovered by M. Teisserenc de Bort, whose recent death meteorologists of every country lament, is called the stratosphere; the lower part of the atmosphere is the part that is churned up by ascending and descending convection currents, and is called the troposphere. The height at which the stratosphere is reached, as well as the temperature of the layer, varies from day to day and from place to place. In these latitudes it is met with at heights varying from about 8 to 14 km., with temperatures varying from $-40°$ to $-80°$ C.

It is not, however, with temperatures that I am chiefly concerned to-night, but with the wind currents in the different layers of the atmosphere. If one of the balloons carrying instruments, or a smaller pilot-balloon, is observed with a theodolite, its position from minute to minute can be determined, and from its trajectory, or its path, as it ascends, the winds that it encounters can be calculated.

The theodolite used is constructed specially for the purpose; a prism in the telescope reflects the light at right angles, so that the observer is always looking in a horizontal direction, even if the balloon is overhead. It is important that the observer should be in as comfortable a position as possible, for an ascent sometimes lasts more than an hour and a half, during which time the observer can only take his eye from the telescope for a few seconds at a time, otherwise he may lose sight of the balloon and be unable to find it again.

The balloon having been started from one end of th base, observations are taken from both ends at exactl the same times, usually every minute. From the positions of the balloon at each successive minute, which are plotted on a diagram, the run of the balloon during the minute can be measured, and hence the wind velocity during that minute can be obtained. After the wind velocities have been measured off, and the wind directions obtained from the directions of the lines on the diagram, another diagram is constructed showing the relation of the wind velocity and direction to the height.

It is not necessary, however, to have two observers if the rate of ascent of the balloon is known; in such a case, the complete path of the balloon can be calculated from the observations of one theodolite. It is not, however, possible to know the rate of ascent with complete accuracy, as up and down currents in the air will affect the normal rate. In practice, especially in clear weather, the method is fairly satisfactory. The method of one theodolite requires less preparation, and the subsequent calculations of the path of the balloon are less laborious, than in the case of observations taken with two theodolites from opposite ends of a base line.

The best time for observations is towards sunset, so that the balloon reaches its greatest height after the sun has set on the surface of the earth; at such times the balloon, still illuminated by the sun, shines like a planet, and on one occasion I should have found it impossible to tell which was the balloon and which was Venus, except for the movement of the balloon. The distances at which balloons may be seen through the telescope of the theodolite are remarkable. A striking instance was when the flash of the sun on the small meteorograph was seen, not once, but repeatedly, when the balloon was about nine miles above the sea and at a horizontal distance of about thirty miles.

In considering the structure of the atmosphere, as it has been revealed by the observations I have carried out, principally at Ditcham on the South Downs, we may divide the subject into two parts: first, the wind structure in the lowest kilometre, and secondly, the general wind distribution up to the greatest heights reached by the balloons.

It is a matter of common observation that the wind increases above the surface, and in these days of aërial navigation it is important to know the law of this increase. It seems that at Ditcham, the increase in velocity is at first linear or nearly so, and that the line representing the linear increase passes through zero velocity at sea-level. That is to say, if we plot the wind velocity at the surface and draw through it a line from zero velocity at sea-level, the wind velocities at other heights, up to half a kilometre to one kilometre, will lie very nearly on this line; this approximately linear increase has been found to agree with observations at several land stations, but over the sea other conditions probably prevail.

But there are occasions when this state of things does not apply at all; this is often the case in light breezes, and at times, when the surface wind is very shallow, giving place to an entirely different wind *régime* in the first kilometre of height. At such times it often happens that the wind velocity is greatest a very little way above the surface. The fact that there are two separate conditions emphasises the danger of taking means. By taking the mean value of a number of separate observations we might get as a result that the wind neither increased nor decreased in the first kilometre of height, which in reality is only true on very rare occasions. As has been truly said, "La méthode des moyennes c'est le seul moyen de ne jamais connaître le vrai!"

Another question of great importance to aviators is the effect of hills upon the winds blowing over them. The balloons used in my investigations ascend at the rate of 500 ft. per minute, and in a few minutes are carried beyond the reach of ground eddies; in some cases, however, I have found that a balloon rose with more than its normal velocity when passing over hills if a strong wind was blowing, and the effect is visible sometimes even when the balloon is more than a kilometre above the surface; on other occasions very little effect has been observed. More light is being thrown on this question by the observations of Mr. J. S. Dines on slowly ascending balloons.

The lower layers of the atmosphere up to one or two kilometres are the most important to aviators. To meteorologists the higher layers offer problems of greater interest. In considering the winds in the free air it is convenient to have some datum to which to refer them. The observed surface wind is not convenient for this purpose, being too much affected by local conditions near the ground. A better datum is what is known as the gradient wind. Under the influence of the barometric gradient the air is being pressed towards the areas of low pressure, but the wind is actually blowing more or less along the isobars at right angles to the force. In much the same way, water in a basin, when allowed to escape through a hole in the centre, and when given a slight movement of rotation, moves round the basin at right angles to the forces which are pressing it towards the centre. In the case of the atmosphere the turning movement is given by the rotation of the earth under the moving air. For any pressure condition to be maintained the air must be moving with a certain definite velocity, depending on the shape of the isobars and the steepness of the barometric gradient. This rate can be calculated for the conditions obtaining at the time, and the wind so calculated is called the gradient wind. It has been found that there is a fairly good agreement between the wind so calculated and the observed wind at a height of $\frac{1}{2}$ km. or so, but owing to friction the surface wind is usually of a smaller velocity, and directed more towards the low pressure.

In order to show in a clear manner the changes of wind at different levels, I have prepared some models which give a better mental picture of the conditions than a diagram. The atmosphere is supposed to be divided up into layers each 1 km. thick and the average wind in each layer is represented by a coloured card; the length of the card represents the velocity of the wind, 1 cm. representing 1 metre per second, 1 metre per second being about $2\frac{1}{4}$ miles per hour; the direction of the card shows the direction of the wind, the arrow flying with the wind. The red cards represent winds that may be supposed to bring air from an equatorial direction, that is winds from east-south-east through south to west-north-west, the blue cards winds that may be supposed to bring air from a polar direction.

For convenience I have divided the wind structures into five types; they are perhaps rather artificial, as I shall show later, but it is convenient to make some sort of classification, even when further knowledge must change it. In the first three types of wind structure, the wind increases above the surface and equals the gradient velocity at a height of $\frac{1}{2}$ km. or so; above this in the first class the wind remains more or less equal to the gradient velocity, up to a height of 7 or 8 km.; in the second class the wind in the upper air greatly exceeds the gradient wind, and in the third class it falls off again to a lesser value; but in all three classes the direction remains much the same as that of the gradient wind.

The first type may be called the solid current; it does not seem to be associated with any particular type of isobars, but in a preponderance of cases the wind is easterly, and the remaining cases are nearly all westerly; it is rare to find the solid current with winds from the north, or from the south.

In rare cases there is scarcely any wind up to the greatest heights reached, and the little wind there is often blows from varying directions in different layers; this type, which may be looked on as a sub-class of the first type, sometimes occurs in still anticyclonic conditions in summer.

In the second class the gradient wind, after being reached at a height of about $\frac{1}{2}$ km., is greatly exceeded in the upper air; in some cases the wind at 2 or 3 km. is double the gradient value, or even more. This type is likely to occur when there is a low pressure to the north of the station and when there is a strong temperature gradient, such that the low temperatures correspond to the low pressures, and *vice versâ*; such conditions should theoretically cause an increase in wind velocity in the upper air, but it is not possible to calculate what the effect should be without knowing the temperatures, not only on the surface, but in the upper air over the region in question. One may, however, calculate what effect surface temperatures would have on the isobars at, say, 3 km., assuming that the vertical temperature gradient is the same at every point; a map constructed to show the isobars which have been thus calculated must be looked on as a rough approximation only to the real conditions. A map of the isobars at 3 km. for May 11, 1907, shows how much steeper was the gradient on this day in the upper air than it was on the surface, a fact which quite accounts for the rapid increase in wind velocity from 2 metres per second at the surface to 19 metres per second at 3 km.

Winds belonging to this class may come from any point of the compass.

The third class comprises those cases in which the wind, after reaching the gradient velocity in the first ½ km. or so, falls off more or less rapidly in the upper air. This class is almost entirely associated with easterly winds on the surface, when there is high pressure to the north and low pressure to the south. An east wind is usually, though not always, a shallow one; a south-west gale increases in the upper air, but when an easterly gale is blowing, causing such high seas and such dangers to shipping, it is curious to reflect that such a short distance up we should meet with light breezes, or even a complete calm.

We now come to the class of reversals when the wind in the upper air is very different in direction from that near the surface, and when it often bears no relation to the surface pressure distribution. In a typical case, after an initial increase for a short distance above the surface, we find the wind gradually decreasing as we ascend, until a layer is met with in which there is a complete calm; above this we find an entirely different wind, which usually increases as we go higher, as in the case of winds in the second class. It looks at first sight as though there were a discontinuity in the atmosphere, but I hope to show later that this is more apparent than real. A typical example of a reversal occurred on November 6, 1908, when the surface wind was easterly with a velocity of 17 metres a second, just below 1 km.; above this it fell off to a complete calm at 3 km.; at 4 km. there was a light north-west wind, which increased to a wind of 15 metres per second at 10 km. The weather map for this day is remarkable: over this country there is no sign on the surface of the westerly wind above, but it appears that in Germany, where the pressure was highest, the westerly wind must have been descending and must have divided into two currents, one flowing on as a westerly wind over eastern Europe, the other flowing back as the easterly wind recorded in this country.

There are other cases of reversal which are not so simple as the one described above. In many cases this type is associated with small depressions, or with small areas of high pressure which seem to be relatively shallow. The surface winds are related to these shallow systems, while the upper winds are controlled by larger areas of high and low pressure, shown on the weather maps at places lying farther from the point of observation.

On September 30, 1908, for instance, a southerly surface wind, after remarkable backing, gave place to a calm at 3 km.; above the calm another southerly wind is met with; in this case the surface wind is probably related to the high-pressure system over Germany; the upper wind to the depression approaching from the Atlantic. There was another somewhat similar case on November 16, 1908, though with winds from a different direction; the northerly surface wind backed, and a calm was met with; above this, very unexpectedly, came a thin stream of southerly wind, above which again was a north wind, increasing in velocity with height. In this case the lowest wind was part of the circulation of an anticyclone which was approaching these islands from the Atlantic; the intermediate southerly wind was perhaps the last remaining effect of the anticyclone over the Continent, while the upper wind was the outflow from above a depression near Iceland, a wind which belongs to another class to be noticed later.

In cases of reversal we find that the warm wind flows over the top of the one that comes from a colder region; there must somewhere be a line where the warm current is rising, where it must be cooled dynamically, and where its moisture may condense into cloud or rain. It is interesting to note that in most cases rain occurs somewhere in the region of the reversal, and in summer thunderstorms are frequent. Thunderclouds may often be seen to be in a wind coming from a contrary direction to the wind on the surface, and it seems possible that for anything like a sustained thunderstorm something in the nature of a reversal must exist; it is difficult to see how a difference of potential, sufficient to produce lightning, can be kept up unless winds from different directions are bringing masses of air at different potentials near to one another.

It has been noticed in Hampshire that when the sound of gun-firing in the Channel is distinct, it is, in summer, a sign of thunder; an explanation may be hazarded; if there is a reversal so that the upper wind is coming from the south, the sound waves travelling from this point with a slight upward tendency will be refracted on entering the upper current, and thus, instead of being dissipated in the upper air, may again reach the surface at a considerable distance from their point of origin. Such conditions of wind are those productive of thunderstorms. This may also possibly account for the superstition that gun-firing produces rain; the sound of guns is only carried to great distances under the conditions I have mentioned, which are precisely the conditions favourable for heavy rains.

A north-east wind with rain lasting many hours is a common and a very unpleasant type of weather; it is not obvious where the moisture comes from with such a wind, for the air from the dry regions of the Continent could scarcely become saturated in its short passage over the North Sea. I believe the moisture comes from the Atlantic in a south-westerly wind in the upper air. Balloons cannot be followed for any length of time in such weather, but I have sometimes observed that the north-easterly wind slackens considerably below the cloud level, and sometimes, when breaks in the clouds have enabled balloons to be followed a little farther, there have been unmistakable signs of reversal. A careful watch for upper clouds, seen through rifts in the lower cloud sheet, will often indicate an upper southerly wind. So sure do I feel of these facts that, though living only twelve miles from the Channel, I never hesitate to send up an instrument-carrying balloon in rainy weather with a north-easterly wind, feeling certain that, though the balloons may go towards the sea at first, they will ultimately return and fall on dry land. My confidence is usually justified by the balloons coming to earth in the Midlands or eastern counties.

The last type of wind structure to be considered is the outflow that seems to take place from the upper layers over a low-pressure system, causing west to north winds in the upper air on the east and south sides of the depression. Depressions out in the Atlantic, which cause south-west winds on the surface, give rise to west or north-west winds in the upper air over England; even cyclones so far off as Iceland produce such winds, and as they pass along the Arctic circle, between Iceland and Norway, they show their presence by an upper northerly wind over this country. As the upper wind is often quite different from that on the surface, reversals are frequent in this class, and are associated as usual with rains, and with thunderstorms in the summer. It may be that much of the rain that falls in the cyclonic depression is due to the rising of this outward flowing current over the very different surface current on the east and north-east sides of the depression.

In connection with the subject of reversals, I may mention the wave and ripple clouds that form such beautiful skyscapes. It used to be supposed that these were formed by winds from different directions flow-

ing over one another and setting up waves; but the observations of pilot balloons have shown that between two currents from different directions there is either a layer of calm, or else the wind changes round gradually; two very different currents are not found in close juxtaposition: there is no abrupt transition between them.

To show the relation of the different types of wind structure to the surface pressures a model has been prepared; on the map are shown a depression and an area of high pressure, with arrows to show the wind directions; above the map is a sheet of glass to represent the first 5 km. of the atmosphere; on this are marked the winds one would expect to meet with at this level under the conditions of pressure supposed; above this sheet of glass is another representing the thickness of the atmosphere from the 5-km. level to the stratosphere. The model is on the scale of one-millionth, the vertical scale through the glass being approximately the same as the horizontal scale.

The churning up of the air resulting from the heating of the surface layers by contact with the earth heated daily by the sun, does not presumably reach into the stratosphere; there being no vertical movements, we should expect to find only such horizontal movements as are consistent with a suitable distribution of density. In the simplest cases the wind increases in velocity until a maximum is reached just below the stratosphere; above this the wind begins to diminish, and sometimes falls off in a very marked manner. There are occasions when all real wind seems to have ceased, and the balloon as it ascends through this curious region moves first in one direction and then in another, so that the relation of wind direction to height can only be represented on a diagram by a disconnected series of points.

What takes place still higher? Does this region of calm extend to the very confines of the atmosphere? We have practically no evidence to go on. In February, 1909, a meteor left a magnificent streak which was visible for two hours and a half; this trail, which was some forty miles above the surface of the earth, moved in a manner suggesting very high wind velocities, with sudden variations in the different layers through which it passed. But it is possible that the streak of a meteor may partake of the nature of an aurora, the luminous patches of which sometimes move in a remarkable way, and probably under forces other than those of the winds.

Having for purposes of classification divided the wind structure of the atmosphere into different classes, I must now attempt to put them together, and to show that some of the types that seem very different are in reality closely connected.

Following on inquiries made by Mr. W. H. Dines on the correlation between the surface pressure and various meteorological elements at a height of 9 km., it was suggested by Dr. W. N. Shaw, F.R.S., that the changes of pressure to which our changes of weather are due have their origin, not near the surface of the earth, as hitherto supposed by many meteorologists, but just below the level of the stratosphere, at a height of 9 km. or so above the surface. This view is in accordance with the observed facts of the wind distribution in the different layers of the atmosphere.

Supposing that on a certain day there is a pressure distribution just below the stratosphere, which at that level produces a westerly wind of a certain strength; this pressure distribution will be transmitted through all the lower layers of the atmosphere, and unless modified by other conditions will produce a west wind at the surface; the velocity of this wind will, however, be only about one-third of that at the 9-km. level owing to the greater density of the air near the surface. If, however, the air to the north at every height were at a lower temperature than the air at a corresponding height over the place of observation, there would be at all levels a tendency for easterly winds. This will have the effect of reducing the westerly wind as we descend through the atmosphere, and when the surface is reached the west wind will have a much lower value than it would have had were it only for the increased density of the air. If the wind at the 9-km. level is not very strong, or if the tendency to produce an easterly wind is strong, as would be the case if the air to the north were very cold, we may get a calm at the surface, or the calm may even be reached at some distance above the surface, in which case the tendency for easterly winds may actually produce such a wind, which will increase in velocity as we descend towards the surface under the layer of calm, and be strongest a little above the surface of the earth, at a point where surface friction begins to cause a diminution of velocity.

If, again, at the 9-km. level, there is a pressure distribution producing an easterly wind, cold air to the north will produce a tendency for an increase of easterly wind as we descend through the atmosphere; but the greater density of the air at the lower levels will produce a decrease of wind velocity from whatever direction the wind may be coming; the two tendencies may neutralise one another, in which case we get a solid current of east wind between the stratosphere and the ground level.

If there is no wind at the 9-km. level, cold air to the north will produce easterly winds in the lower levels, in which case we should find easterly winds increasing in velocity as the surface is approached.

These considerations give some idea of the mechanism by which the different types of vertical wind structure may be produced. The wind increasing in height, the solid current, the wind decreasing with height, are seen to fall into their places. The reversal, with an east wind near the surface and a west wind higher up, is only an extreme case of the slackening of the westerly wind near the surface; and the point of reversal, far from marking a point of discontinuity in the atmosphere, is seen to be merely the result of forces extending right through the lower part of the atmosphere, between the stratosphere and the earth.

If the winds are resolved into components at right angles to each other, that is north-south and west-east components, it is found that in most cases the west-east component decreases below the stratosphere and is a minimum near the surface, an east wind in this case being considered as a negative west wind. This is what should be the case if the ideas I have been considering are correct, for the air to the north is generally colder than the air over this country. In the case of the north-south component we find no such general rule, but this also is as it should be, for the air to the east and west may be either of the same temperature, or warmer, or colder than the air over the station; in other words, there is a normal north to south temperature gradient but not a normal west to east gradient, in our islands.

The supposed cases mentioned are, of course, simple types, and it can readily be understood how varying conditions of pressure and temperature may in similar ways produce varieties of vertical wind distribution. In considering the pressure distribution just below the stratosphere as the regulator of the winds and the weather in the lower part of the atmosphere, I fear I have nothing to add concerning the laws governing these pressure distributions; the idea is a new one, and has yet to be worked out in its details, and to stand the test of criticism and fuller investigation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l.* a year tenable for two years is offered each year by the governing body of Emmanuel College to a research student commencing residence at Cambridge as a member of Emmanuel College in October. Applications, accompanied by two certificates of good character, should be sent to the master of Emmanuel not later than September 24.

The next combined examination for fifty-six entrance scholarships and a large number of exhibitions at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 2, and following days, commencing at 9 a.m. on Tuesday, December 2. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural sciences. A candidate for a scholarship or exhibition at any of the six colleges must not be more than nineteen years of age on October 1, 1913. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges, from any of whom further information respecting the scholarships and exhibitions and other matters connected with the colleges may be obtained. The forms of application must be sent in on or before Saturday, November 22.

Mr. W. Dawson has been appointed reader in forestry in the University until September 30, 1917.

OXFORD.—Additional buildings are about to be provided for research and teaching purposes in connection with the School of Forestry. The expense will be met partly out of the funds at the disposal of the Delegates for Forestry, and partly by a grant of 1000*l.* from the Development Fund controlled by the Treasury. The Council of the Surveyors' Institution has contributed 210*l.* towards the cost of a research laboratory on the diseases of trees.

Convocation has authorised the curators of the University Chest to receive the sum of 6000*l.* from the trustees of the University Endowment Fund, to be applied to the building and equipment of the new laboratory of engineering science, as soon as the allotted site shall have been legally secured to the University.

DR. J. ARGYLL CAMPBELL, junior assistant to Prof. Schäfer, in the University of Edinburgh, has been appointed professor of physiology in the University of Singapore.

THE fortieth annual dinner of the old students of the Royal School of Mines will be held on Monday, June 9, at the Café Monico, Piccadilly Circus. Mr. Frank Merricks will be in the chair. Tickets may be obtained from the hon. secretary, Mr. T. A. Rickard, 820 Salisbury House, E.C.

THE St. George's Gallery, New Bond Street, was the scene last week of an interesting exhibition of photographs of the Holy Land. These photographs were the work of Miss Sophie Nicholls, who travelled in Palestine in 1910–11 as a Frances Mary Buss travelling scholar. The scenic and panoramic views force upon the mind the aridity of the land, the apparent unchangeable character of the works of man in the towns or villages which are tucked, as it were, into crannies of the bleak hill slopes. A set of twelve of the most typical views has been compiled for the use of schools and colleges, and an explanatory book containing topographical maps showing the position of the camera and its range of view is in preparation. Particulars of these publications may be obtained from Messrs. J. A. Sinclair and Co., Ltd., 54 Haymarket, S.W.

THE Board of Education has issued (Cd. 6795) its regulations for the training of teachers for elementary schools, to come into force on August 1 next. Substantial changes will then be made with regard to the curriculum and examinations of students who will follow the ordinary two years' course of the training college. The majority of students entering the training colleges now have had four years' education in a secondary school, whereas, when the old regulations for training colleges were drawn up, the general education of their students on entry was often very meagre. The changes are in the direction of diminishing the time devoted to general education by the training-college student and increasing that given to what are called "professional" subjects. More prominence, too, is to be given to practical work in teaching while at college. It has been found necessary to add to the equipment of the primary-school teacher a knowledge of hygiene and physical training, and both these subjects are classed as professional. Elementary science is rightly considered a subject of general education. Physics, chemistry, botany, rural science, and housecraft are called "additional," or "subjects which are not ordinarily needed by elementary-school teachers, but which may in certain cases be included in the training-college curriculum, either because they would be useful for teachers in schools f a special type, or because the student may desire to study them with a view to improving his own general education."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 8.—Sir Archibald Geikie, K.C.B., President, in the chair.—A. D. **Waller**: The various inclinations of the electrical axis of the human heart. This paper is in substance the direct continuation of a communication made to the society in 1889 (Phil. Trans., p. 169), in which it was shown (1) that the electrical effects accompanying the beat of the human heart can be demonstrated and studied by "leading off" from the mouth and from the extremities; and (2) that in consequence of the oblique situation of the heart in the thorax these "leads" are to be classified as favourable and unfavourable or strong and weak. Of the six possible leads from the four extremities, three are strong (transverse, axial, right lateral) and three are weak (inferior, equatorial, left lateral). Of the four possible leads from the mouth and one extremity, one is weak (right superior) and three are strong (left superior, right and left inferior). The electrical equator is an imaginary line of zero potential across the chest from left shoulder to right side. The electrical current axis is from right shoulder to left side, at right angles to the equator.—Surgeon-General Sir D. **Bruce**, Majors D. **Harvey** and A. E. **Hamerton**, and Lady **Bruce**: Trypanosome diseases of domestic animals in Nyasaland. III., *Trypanosoma pecorum*.—T. **Goodey**: The Encystation of *Colpoda cucullus* from its resting cysts and the nature and properties of the cyst membranes. The ectocyst ruptures and sets free the transparent endocyst. Both ectocyst and endocyst are composed of carbohydrate substances and are resistant to acids, weak alkalies,

and many other reagents; failing to give any reaction with iodine in potassium iodide solution. The endocyst is composed of a new carbohydrate for which the name Cystose is proposed. During encystation the endocyst wall is digested by a powerful enzyme secreted by the enclosed organism, and by this means the latter is enabled to escape. The name Cystase is proposed for this enzyme.—C. **Shearer**, W. De **Morgan**, and H. M. **Fuchs**: The experimental hybridisation of Echinoids.

CAMBRIDGE.

Philosophical Society, April 28.—Dr. Shipley, president, in the chair.—A. H. **Evans**: Notes on additions to the flora of Cambridgeshire. The author stated that the combined efforts of the staff of the botany school, research students, and undergraduates had resulted in a large addition to the list of species given in his "Short Flora of Cambridgeshire" (Proc. Camb. Phil. Soc., xvi., part 3), while others of great interest had been discovered in new localities or rediscovered in their former stations. Of these perhaps the most interesting was the rare *Prunella laciniata*, but lately known to have occurred in England, while Mr. Moss had found with it what appeared to be undoubted hybrids with *P. vulgaris*.—H. Hamshaw **Thomas**: Some new and rare Jurassic plants from Yorkshire. In this communication Eretmophyllum, a new genus of plants allied to the Ginkgoales, is described. It is founded on leaves which possess the nervation, secretory tracts, and stomatal structure characteristic of Ginkgo leaves, while in their linear or oblanceolate shape they rather resemble those of Podozamites.—C. E. **Moss**: Some plants new to the British Isles. Rev. M. J. **Le Goc**: Observations on *Hirneola auricula-judae*, Berk. (Jew's ear). The author deals in his paper with the biology of *Hirneola auricula-judae*, Berk., "Jew's ear," with special reference to pure cultures in various media, to the fructifications obtained in these cultures, and to the action of the hyphæ on the tissues of the host.—Prof. A. C. **Dixon**: (1) The greatest value of a determinant the constituents of which are limited. (2) Expressions for the remainders when θ, θ', $\sin k\theta$, $\cos k\theta$ are expanded in ascending powers of θ.

May 5.—Prof. Nuttall in the chair.—Prof. **Nuttall**: Observations on ticks: (*a*) parthenogenesis, (*b*) variation due to nutrition. The occurrence of parthenogenesis in ticks was recently observed by Aragão, in Brazil, in a new species of Amblyomma (*A. agamum*), the males of which have not as yet been discovered. Three complete generations of this tick have been raised experimentally and thousands of females were brought to maturity in the absence of males. This constitutes the first record of parthenogenesis in ticks. Prof. Nuttall described how he had succeeded in obtaining a parthenogenetic offspring from *Rhipicephalus bursa*, a species (prevalent on sheep in countries bordering the Mediterranean) in which both sexes occur in fairly equal numbers upon the host. Larval ticks issued in limited numbers from the eggs laid by unfertilised females. Experiments were further recorded in which it was shown that the genus Rhipicephalus shows a considerable natural variation in size, and that imperfect feeding of the tick in its immature stages leads to the development of very small adults which, whilst fertile, are so different from the normal forms that they could readily be taken for other species.—E. **Hindle**: Exhibition of a Chinese flea-trap. The author exhibited an ingenious device for catching fleas commonly employed by the natives of Setchuen, western China. The apparatus consists of two pieces of bamboo one inside the other. The inner bamboo is coated with bird-lime to which any fleas adhere, whilst the outer one merely protects the sticky surface from coming into contact with bedclothes, &c., but is fenestrated in order to allow the free entrance of fleas.—Prof. A. D. **Imms**: Exhibition of living termites. The author exhibited tubes containing living examples of the termite *Archotermopsis wroughtoni*, Desn. The termites were obtained by him from the Kumaon Himalayas, where they occur in dead trunks of the Chir pine (*Pinus longifolia*) at an altitude varying from about 4500 to 5800 ft.—K. R. **Lewin**: The division of *Holosticha scutellum*. The account of the behaviour of the micronuclei at division, given by A. Gruber ("Weitere Beobachtungen an vielkernigen Infusorien," *Ber. Naturf. Ges. zu Freiburg I.B.*, Bd. iii. (1887), pp. 57–70), is not confirmed. In the period between divisions, *H. scutellum* possesses only a small number of micronuclei of about the size of the meganuclear segments, with which they have been confused. There is therefore no necessity to assume that numerous micronuclear divisions occur at the fission of the infusorian.—H. B. **Fantham**: *Sarcocystis colii*, n. sp., a Sarcosporidian occurring in the red-faced African mouse bird, *Colius erythromelon*. The author gave an account of a new species of Sarcosporidia from a new avian host. The Sarcosporidian trophozoites (Miescher's tubes) were distributed throughout the skeletal musculature, being more concentrated in some areas than in others. They occurred also in the heart muscle, and were scattered in the pericardium, peritoneum, and in the intestinal mesentery.—J. T. **Saunders**: Note on the food of freshwater fish. The food of fish varies considerably, many different things being taken by one species as an article of diet. But a single fish does not eat indiscriminately everything that it comes across; on the contrary, its meals are found usually to consist of one kind of food only. A mixture of food is not often found in the stomach, and this will only occur when the fish is very hungry or under artificial conditions, such as obtain in a laboratory aquarium. The food also varies according to locality, even in ponds which are separated from each other by only a few yards; the food in the stomachs of fish taken from these ponds may be quite different. This variation affects equally all the individuals that live in the same pond; under the same conditions they will all feed on the same food.

PARIS.

Academy of Sciences, May 13.—M. F. Guyon in the chair.—Paul **Appell**: The polynomials $V_{m,n}$ of Hermite and their analogues connected with spherical functions in space of any number of dimensions.—Armand **Gautier** and P. **Clausmann**: Fluorine in the animal organism. Skeleton, cartilages, tendons. Determinations of amounts of fluorine in bones and teeth, cartilage, and tendons of mammals and fish. Fluorine has been found in all the organs examined, but the proportions vary widely. Fluorine is localised in a definite manner in the organism; it accompanies the phosphates of the alkaline earths and increases with them.—Paul **Sabatier** and M. **Murat**: The preparation of several di*cyclo*hexylbutanes. Description of the preparation and properties of five out of the nine possible isomeric di*cyclo*hexylbutanes.—L. de **Launay**: Some broken-up rocks of the Central Plateau (France).—M. de **Forcrand**: Trouton's law. The relation $L/T = \text{constant}$ (about 22) is known not to hold in many cases, the value of L/T varying from 4·5 for helium to 0·27 for copper. Nernst has suggested $L/T = 9{\cdot}5 \log T - 0{\cdot}007\,T$. This gives a closer approximation to experiment, but is still unsatisfactory. The author further modifies this formula to

$$L/T = 10{\cdot}1 \log T - 1{\cdot}5 - 0{\cdot}009\,T + 0{\cdot}0000826\,T^2.$$

Between 250° and 900°, this gives a value for L/T approximating to 22, the original Trouton constant.—Ph. **Barbier** and R. **Locquin**: The methodical degradation of some monobasic and dibasic acids (see p. 303).—MM. **Fayet** and **Schaumasse**: The provisional orbit of the new comet 1913*a* (Schaumasse). The comet will be best seen about the beginning of June.—Gaston **Cotty**: The reduction of binary quadratic forms with integral coefficients in a real quadratic body.—E. **Landau**: Lambert's series.—Jules **Andrade**: Lateral independence of the balance spring in marine chronometers. Diminution of the variation from isochronism due to inertia.—A. **Cotton** and H. **Mouton**: The magnetic double refraction of liquids. The magnetic double refraction of solutions of nitrobenzene in carbon tetrachloride shows wide variation from an additive law; the specific double refraction of the nitrobenzene appears to be reduced by the addition of an inactive diluent.—R. **Fortrat**: The simplification of lines of the spectrum by the magnetic field. A study of the effect on the lines of a very strong magnetic field (40,000 Gauss). In the case of the green band of carbon the field reduced all the doublets to single lines, and the triplets were also reduced to single lines when the three lines were fairly close together. Similar effects were also noted in the blue band of the Swan spectrum, and the spectrum of the negative pole of nitrogen. The phenomenon appears to be general in band spectra.—M. de **Broglie** and F. A. **Lindemann**: The optical phenomena presented by the Röntgen rays meeting crystalline media. An examination of the various hypotheses proposed for explaining the production of fringes described in an earlier paper. The hypothesis that the fringes are caused by reflections on the cleavage planes of the crystal agrees best with the experimental results.—L. **Gay**: The calculation of the latent heats of evaporation. A modification of the Clapyron formula is proposed, partly based on Nernst's expression.—Louis **Hackspill**: The solid hydrogen phosphides. The alkaline phosphides of the type M_2P_5, described in a previous communication, give a solid hydrogen phosphide on treatment with dilute acetic acid, and this on analysis gives figures agreeing with the composition H_2P_5.—J. **Bougault**: Phenyl-α-oxycrotonic acid, its preparation and a new isomeride. A study of the best conditions of obtaining the acid from its amide; the hydrolysis of the latter is best carried out by heating with a solution of oxalic acid. An isomeride was obtained in the course of this work which differed from those previously known; it would appear to be the enolic form of benzoylpropionic acid.—Edouard **Bauer**: 1-Benzoyl-2-phenyl-Δ_2-*cyclo*pentene.—Maurice **Lugeon** and Mlle Elisabeth **Jérémine**: The presence of limestone bands in the Swiss part of the massif of the Aiguilles Rouges.—V. **Vermorel** and E. **Dantony**: Fungicidal pasty solutions possessing moistening power. It is important that the copper preparations used in viticulture should moisten the leaves. This effect can be secured by the addition of gelatine to solutions with acid reaction and casein to alkaline solutions.—Ch. **Brioux** and M. **Guerbet**: Sulphur in the soil: study of its oxidation. The oxidation of the sulphur in the soil is shown to be due to microbial action. The phenomenon is complicated, several bacteria appearing to take part in the oxidation.—J. M. **Lahy**: Organic adaptation in states of attention.—Raoul **Bayeux**: The comparative resistance of the dog and the rabbit to intravenous injections of carbonic acid. The ratio between the receptivity of the dog and the rabbit is the same for carbonic acid as for oxygen; in the two cases the volume of the former gas is five times greater than that of the latter.—P. **Chaussé**: The methods to be used for experimental tuberculosis by inhalation. Details of the methods used for the pulverisation of wet and dry virus.—Jacques **Pellegrin**: A new genus of the Centrarchideæ of the Gabon.—Charles **Lepierre**: The replacement of zinc by copper in the culture of *Aspergillus niger*. Copper, like cadmium, uranium, and beryllium, may replace zinc in Raulin's solution, and has the same effect in causing a rapid growth of the mould.—H. **Bierry** and Z. **Gruzewska**: The estimation of glycogen in the muscles.—Em. **Bourquelot**, H. **Hérissey**, and M. **Bridel**: The biochemical synthesis of the glucosides of alcohols (α-glucosides) by the aid of a ferment, α-glucosidase, contained in the yeast from low beer, air dried. α-Propylglucoside and α-allylglucoside.—L. **Cayeux**: The genesis of sedimentary iron minerals.—Pierre **Bonnet**: The structure of the chains between Lake Gœktchaï and the Araxe.

BOOKS RECEIVED.

Atlas Notes. By J. C. Chute. Pp. 82. (London: Oxford University Press.) 1*s*.

Dent's Practical Notebooks of Regional Geography. By Dr. H. Piggott and R. J. Finch. Book iii. Africa. (London: J. M. Dent and Sons, Ltd.) 6*d*. net.

The Fishes of the Stanford Expedition to Brazil. By Prof. E. C. Starks. Pp. 77+xv plates. (California: Stanford University.)

The Statesman's Year-Book, 1913. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Pp. xcvi+1452+x plates. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

The National Physical Laboratory. Report for the Year 1912. Pp. 123. (Teddington: W. F. Parrott.)

Report for 1912 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. W. A. Herdman. Pp. 318+iii plates+v charts. (Liverpool: C. Tinling and Co., Ltd.)

Flowerless Plants: How and Where They Grow. By S. L. Bastin. Pp. xi+152+plates. (London: Cassell and Co., Ltd.) 6*s*. net.

Metamorphose der Muraenoiden. By Dr. B. Grassi. Pp. x+211+xv plates. (Jena: G. Fischer.) 50 marks.

Papers Set in the Mathematical Tripos, Part i., in the University of Cambridge, 1908–12. Pp. 70. (Cambridge University Press.) 2*s*. 6*d*. net.

A Text-Book of Thermodynamics (with Special Reference to Chemistry). By J. R. Partington. Pp. viii+544. (London: Constable and Co., Ltd.) 14*s*. net.

The Laws of Thermodynamics. By W. H. Macaulay. Pp. viii+71. (Cambridge University Press.) 3*s*. net.

The Principles of Projective Geometry applied to the Straight Line and Conic. By J. L. S. Hatton. Pp. x+366. (Cambridge University Press.) 10*s*. 6*d*. net.

Insects: Their Life-Histories and Habits. By H. Bastin. Pp. xii+349+xlvi plates. (London and Edinburgh: T. C. and E. C. Jack.) 7*s*. 6*d*. net.

Mathematical Physics. Vol. i., Electricity and Magnetism. By C. W. C. Barlow. Pp. vii+312. (London: W. B. Clive.) 4*s*. 6*d*.

An Index to the Scientific Contents of the Journal and Proceedings of the Academy of Natural Sciences of Philadelphia. Pp. xiv+1419. (Philadelphia: Academy of Natural Sciences.) 3.50 dollars.

The Social Guide, 1913. Edited by Mrs. H. Adams

THE BELIEF IN IMMORTALITY.

The Belief in Immortality and the Worship of the Dead. By Prof. J. G. Frazer. Vol. i.: The Belief among the Aborigines of Australia, the Torres Straits Islands, New Guinea, and Melanesia. Pp. xxi+495. (London: Macmillan and Co., Ltd., 1913.) Price 10s. net.

THE publication of Prof. Frazer's Gifford lectures has been awaited with interest by students of anthropology and religion. Their subject was one of the first to occupy the author's attention; his paper on primitive burial customs placed the study of the belief in immortality and the worship of the dead in a new light. He has now given us the first instalment of a comprehensive survey of the whole institution. Psychical and ceremonial though it is, the doctrine and cult form an institution as deserving of the name as political government. The belief in some degree of immortality has been practically universal, and is still a "last infirmity of noble mind"; some form of "worship," fear of the ghost or actual veneration of the deified ancestor, has accompanied the belief in the case of the majority of peoples. The author acutely points out, for the consideration of "historians and economists, as well as of moralists and theologians," that the direct consequences of this moral institution have been grave and far-reaching, such as no mere sentiment could have produced, not only in primitive but in civilised history. It has, he says,

"not merely coloured the outlook of the individual upon the world; it has deeply affected the social and political relations of humanity in all ages; for the religious wars and persecutions, which distracted and devastated Europe for ages, were only the civilised equivalents of the battles and murders which the fear of ghosts has instigated amongst almost all races of savages of whom we possess a record. . . . And when we consider further the gratuitous and wasteful destruction of property, as well as of life, which is involved in sacrifices to the dead, we must admit that with all its advantages the belief in immortality has entailed heavy economical losses upon the races—and they are practically all the races of the world—who have indulged in this expensive luxury."

The treatment of the subject is, so far, merely descriptive; it is not even comparative. But the analysis of belief and practice among the aborigines of Australia, the Torres Straits, New Guinea, and Melanesia, which occupies nearly 400 pages of this volume, is a masterly performance. The intention of the author is to pursue this method from the lower to the higher planes of culture. The savage conception of death as unnatural, and due, first to sorcery, and secondly to the operation of ghosts or spirits, is further studied, and shown in its development towards a recognition of disease and accident as causes. The interesting view of Weismann and Wallace that death in higher organisms may actually be an acquired adaptation is cited in comparison.

There is an extraordinary likeness between the varieties of belief and ceremony, which never degenerates into mechanical sameness. In one case their connection with tabu results in a very sensitive regard for the rights of property; in another, the fear of sorcery leads to a punctilious system of sanitation and scavenging; in several cases the dramatic art finds its beginnings in the ghost-dance and similar propitiatory ceremonial. Incidentally, the author quotes interesting varieties of the belief in the soul, which he assumes, though he does not go further than Tylor's dream-theory, to be the cause of the general belief in survival after death. It is to be hoped that in future volumes the author will treat the cause with the same fullness as he has treated the effect.

A. E. CRAWLEY.

RECENT PSYCHOLOGY AND LOGIC.

(1) *Elements of Physiological Psychology.* A Treatise of the Activities and Nature of the Mind from the Physical and Experimental Points of View. By Prof. G. T. Ladd and Prof. R. S. Woodworth. (Thoroughly revised and re-written.) Pp. xix+704. (New York: Charles Scribner's Sons, 1911.) Price 4 dollars net.

(2) *Formal Logic: a Scientific and Social Problem.* By Dr. F. C. S. Schiller. Pp. xviii+423. (London: Macmillan and Co., Ltd., 1912.) Price 10s. net.

(3) *Der Mechanismus des menschlichen Denkens.* By Erich Ruckhaber. (Humboldt-Bibliothek, Heft 2.) Pp. 126. (Brackwede i. W.: Dr. W. Breitenbach, 1911.) Price 2 marks.

(4) *Religion and Modern Psychology.* By J. Arthur Hill. Pp. vii+200. (London: Wm. Rider and Son, Ltd., 1911.)

(5) *Is the Mind a Coherer?* By L. G. Sarjant. Pp. 304. (London: George Allen and Co., Ltd., 1912.) Price 6s. net.

THE first two books of those mentioned above are by far the most important of the group. The new, largely re-written edition of (1) Ladd's "Physiological Psychology" will be welcomed by students of psychology. Nearly twenty-five years have passed since the first edition of the book, a period within which the then new branch of experimental psychology has forced its way to the front. Very considerable additions have been made to this book in the section on the physiology of the nervous system. It may be questioned whether such a full study of physiological processes is not better obtained, even by the student of psychology, directly from standard works on physiology. It

has the advantage, however, of forming a selected introduction to the later parts of the work, in which the psychology of the senses obtains the fullest treatment.

In his book (2) on formal logic, Dr. Schiller attacks the fundamental assumption of that science, viz., that one *can* consider the purely formal aspect of truth alone. The book is written in a style quite characteristic of the most prominent upholder of Pragmatism in this country. We have not space to give the book the full discussion which it deserves. We may observe, however, that the fact that all the problems of logic shade off into those of metaphysics or psychology, even if true, does not imply that it cannot do useful and essential work in its own sphere.

(3) In "Der Mechanismus des menschlichen Denkens" the author has sought to present in handier form some of his ideas upon the mechanical interpretation of thought expounded in his larger work, "Des Daseins und Denkens Mechanik und Metamechanik." In the first section he discusses the "feeling of contradiction" as a fundamental factor of all thought. This is followed by a critical consideration of the association theory and the logical, psychological, and physiological objections to it. Memory and thought are dealt with in a third section, in which the unity of brain-function in memory is emphasised.

(4) "Religion and Modern Psychology" would have more aptly been called "Mysticism and Psychical Research." A discussion of mysticism occupies a large portion of the book, and psychical research is of central importance to the author's position, which is that little else can afford satisfactory reasons for belief in a future life. The book is written in a readable style, and contains very numerous quotations—for those who are fond of them. Theism is dismissed in a couple of pages, though the author "distrusts those who arrive at a conclusion too speedily." "Metaphysics," he says on p. 35, "is obsolete in the ontological sense," yet in the concluding chapter he describes, with qualified approval, a crude metaphysic which gives a sort of world soul to each of the heavenly bodies.

(5) The last-named book is a metaphysical essay which will probably prove highly amusing to the trained philosopher, but highly confusing to the novice. The book begins with the question, "Do you ever go out of your mind, reader?" and we must confess that in reading the book we have several times felt that we did. We regret that space forbids us to quote one of the many passages which rival anything we have met for obscurity of thought and confusion of language.

ANATOMY, NORMAL AND MORBID.

(1) *The Essentials of Morbid Histology.* For the use of students. By Prof. A. S. Grünbaum. Pp. xvi+219. (London: Longmans, Green and Co., 1912.) Price 7s. 6d. net.

(2) *Die Muskeln des Stammes.* By Prof. P. Eisler. (Handbuch der Anatomie des Menschen. Herausgegeben von Prof. K. von Bardeleben. Zweiter Band. Zweite Abt. Erster Teil.) Pp. xii+705. (Jena: Gustav Fischer, 1912.) Price 38 marks; subscription price, 35 marks.

(3) *Neue Lehre vom zentralen Nervensystem.* By Dr. Em. Rádl. Pp. vii+496. (Leipzig: W. Engelmann, 1912.) Price 12 marks.

(1) THE aim of Prof. Grünbaum's book is to provide the student of pathology with a manual that will serve the same purpose as Prof. Schäfer's well-known book on histology does for the student of normal anatomy. The author has succeeded in compressing into a small compass a great deal of information (and an excellent series of well-chosen figures) without any sacrifice of lucidity of treatment. To select from the enormous amount of material now available the subject-matter for a small manual upon morbid histology for students is a task of great difficulty, and perhaps no two pathologists would make precisely the same choice. It would be easy to criticise any such selection as this book contains; but, on the whole, Prof. Grünbaum has succeeded in producing a work that will be welcomed by all medical students, and we think by most teachers of pathology and medicine. The publishers are to be heartily congratulated on the excellence of their work, and especially on the clearness of the illustrations.

(2) Everyone who has had occasion to refer to that great anatomical library known as Bardeleben's "Handbuch," of which Prof. Eisler's volume constitutes the twenty-first "Lieferung," must have been impressed with the extraordinary inequality of the different volumes, both as regards the material and the manner in which the information is presented. This large treatise on the muscles of the trunk is one of the best volumes that have yet appeared. Needless to say, a book of 705 pages dealing solely with the trunk muscles of man is a storehouse of detailed information; but its great merit is that most of it is the result of the author's original observations. He freely refers to the work of other investigators, and gives copious illustrative facts from comparative anatomy, but the reader is made to feel that he is getting first-hand information throughout. The illustrations are excellent, both artistically and

anatomically, for they have that kind of accuracy which no artist who is not the investigator and author ever can portray.

As a work of reference and a storehouse of accurate information, Prof. Eisler's monograph will be invaluable.

(3) In the notes upon the other two volumes we have been dealing with facts, normal and pathological; but in Dr. Rádl's excursion into transcendental philosophy we are invited into the realms of ultra-Bergsonian casuistry, which is certainly not the normal environment of the biologist. The major part of his book is devoted to a discussion of the comparative anatomy of the visual organs and related nervous structures, chiefly of invertebrate animals; and the author uses these facts, or rather his speculative interpretation of them, as ammunition for an attack upon the usual methods of biological argument, and especially upon theories of phylogenesis. It is easy to see why he chose the visual organs for this purpose: the data relating to the other sensory mechanisms, if employed as he uses his materials, would all have pointed in the direction opposite to that desired by Dr. Rádl. But the retina grows out from the central nervous system: therefore it is not formed by the influence of environment; it is the material expression of the "neue Lehre" that the mind makes its own instruments! This is the kind of argument, if such speculations can be called argument, that Dr. Rádl indulges in. It seems to the reviewer that Dr. Rádl has not sufficiently acknowledged his indebtedness to Bergson; but, on the other hand, his statement lacks even the superficial plausibility of Bergson's writings.

OUR BOOKSHELF.

Tracks of the Sun and Stars, A.D. 1900 to A.D. 37900. Photographs from Stereoscopic Perspective Drawings made at Tenby, A.D. 1912–13. By Thomas Edward Heath. Pp. 17 + photographs. (London: W. Wesley and Son; Manchester: Flatters and Garnett, Ltd., n.d.) Price 5*s*. net.

IT has probably occurred to many who are interested in the study of stellar motions that it would be instructive to have a model of those star-tracks which are known, so that the phenomena in the three-dimensional aspect might be more easily grasped. By means of Mr. Heath's stereoscopic drawings it is now possible to have such a model before our eyes, and to see in a vivid manner the complex system of motions of a portion of the stellar universe. We have been delighted with the clearness with which the varying inclinations and directions of the interlacing movements are shown. Perhaps the most striking impression is the very considerable change of relative position which takes place in the selected interval of 36,000 years—a period by no means long from the astronomical point of view. The great range of difference in the speeds of the stars is also brought out prominently.

In order to ascertain the complete motion of a star, the proper motion, radial motion, and parallax must be known, the parallax being generally much the most uncertain of these quantities. In some cases where the value is small, Mr. Heath's tracks are rather hypothetical; but recent researches have increased considerably the number of trustworthy parallaxes, and the data used for these drawings appear to be well selected on the whole. Two views are given, in one of which the observer is supposed to be removed 100 light-years, and in the other 200 light-years, from the present position of the sun. The letterpress contains useful instructions for the reader who wishes to make for himself other drawings of this character.

A. S. E.

Die europaeischen Schlangen. Kupferdrucktafeln nach Photographien der lebenden Tiere. By Dr. Fritz Steinheil. Erstes Heft. (Jena: Gustav Fischer, 1913.) Price 3 marks.

ALTHOUGH there is no lack of good figures of most of the snakes of Europe, yet these are mostly executed from preserved specimens. We therefore welcome the publication, of which the first fascicle has just appeared, undertaken by the enterprising firm of Gustav Fischer, in which Dr. Steinheil intends to represent, by means of photographs taken from living examples, the different species of snakes inhabiting Europe, as well as their principal varieties. The five copper-plates now issued could scarcely be surpassed.

The letterpress accompanying each plate is short, and deals merely with the geographical distribution and the habits in captivity; no information is given concerning the mode of reproduction, a subject of particular interest not only to the herpetologist, but also to the amateur who keeps snakes in the terrarium. No systematic order is followed, but a brief introduction explains the classification followed, which, as well as the nomenclature, is in accordance with the British Museum catalogue of snakes, also adopted in Schreiber's recently issued second edition of the "Herpetologia Europæa." In fact, as the author tells us in the preface, this work is intended to serve as an atlas to the "Herpetologia Europæa," and as such will prove of great service.

G. A. B.

Die Methoden der exakten, quantitativen Bestimmung der Alkaloide. By Prof. Anton Ritter von Korczynski. Pp. iv+82. (Berlin: Gebrüder Borntraeger, 1913.) Price 3.50 marks.

THIS little work deals with the methods by which alkaloids may be accurately determined quantitatively, but not with the methods by which the total alkaloids may be extracted from crude drugs or their preparations, although an appendix of fifteen pages contains the details of the alkaloidal drug-assays of the German Pharmacopœia. One-third of the book is devoted to the determination

of quinine; morphine and the opium alkaloids, and strychnine and brucine, occupy the next places of importance, whilst the remaining alkaloids are very briefly discussed. It is essentially a compilation, and, like all compilations, has a distinct value. In this case the value is somewhat adversely affected by the scanty treatment that some of the alkaloids have received. Thus the separation of emetine from cephaëline is simply mentioned, although Paul and Cownley showed long ago how it could be effected, and Farr and Wright have published a method for the accurate determination of colchicine, to which no reference is made; indeed, the results obtained by English workers in this field have been sadly neglected. The utility of the work would be much enhanced by a more thorough examination of the literature.

Manual of Wireless Telegraphy and Telephony. By A. F. Collins. Third edition. Pp. xv+300. (New York: John Wiley and Sons; London: Chapman and Hall, 1913.) Price 6*s*. 6*d*. net.

THIS edition differs from the first, which was reviewed in the issue of NATURE for February 14, 1907 (vol. lxxv., p. 366), in several respects. The improvements in apparatus, and the advances made in wireless telegraphy in other directions, have led Mr. Collins to extend his treatment of the apparatus of a commercial station, and to describe the transmitting and the receiving instruments in separate chapters. The suggestions to operators relating to the management of stations are more exhaustive, and other useful additions have been made.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Artificial Hiss.

CAN any of your readers tell me how to make an artificial hiss? I have heard something like one from steam blowing off at a safety-valve. There the pressure was very high, but in the mouth a hiss is made with a moderate pressure behind. The problem must have been faced by inventors of speaking machines, but I do not know with what success. The best that I have been able to do myself is by blowing through a rubber tube nipped at about half an inch from the end with a screw clamp, but the sound is perhaps more like an *f* than an *s*.

There is reason to think that the ear, at any rate of elderly people, tires rapidly to a maintained hiss. The pitch is of the order of 10,000 per second.

RAYLEIGH.

Terling Place, Witham, Essex.

An Application of Mathematics to Law.

I WOULD not have troubled you with further correspondence on this subject but for the fact that Mr. Potts's letter (April 24, p. 187) illustrates in a remarkable way the value of a knowledge of the fundamental principles of mathematics when possessed by persons occupied in work often apparently of a very unmathematical nature.

Mr. Cripps (May 15, p. 270) appears to belong to the unfortunately too prevalent class of individual who mistakes algebra for mathematics, and he bases his objection entirely on the purely algebraic equation $I=M+i$. He completely overlooks the fact that Mr. Potts's method is based entirely on the great and powerful conception of *functionality*. But if I understand Mr. Potts correctly, the problem in which he is an expert consists in determining the forms and characteristics of certain functions, and not in the mere numerical solution of equations.

G. H. BRYAN.

Overheated Water.

THE experiment of Dufour, in which drops of water were suspended in a mixture of linseed oil and oil of cloves, and heated to 120° C. without boiling, is seldom repeated for class demonstration, presumably owing to the difficulty of preparing a mixture of the oils exactly equal in density to water at the temperature named. The phenomenon may be shown with ease and certainty, however, by employing a mixture of four volumes of ethyl benzoate and one volume of aniline instead of the mixture of oils, the procedure being as follows:—Place 80 c.c. of ethyl benzoate and 20 c.c. of aniline in a beaker, and surround by a bath of glycerine or strong sulphuric acid. Heat the bath until the temperature of the mixture is 125° C., and then add 2 to 5 c.c. of freshly boiled water by means of a pipette. The water will sink at first, and rest on the bottom of the beaker; but on attaining the temperature of the mixed liquids it will break up with some violence into spheres of various sizes, which remain floating in the liquid so long as the equi-density temperature of 125° C. is maintained. It is advisable to place a cover over the beaker to prevent the fuming of the mixture.

For lantern projection, a copper vessel, square in section, and having two opposite sides of patent plate-glass, will be found satisfactory, glycerine being used to surround the beaker and the temperature raised gradually.

CHAS. R. DARLING.

City and Guilds Technical College, Finsbury, E.C.

"Coal, and the Prevention of Explosions and Fires in Mines."

I MUST point out that some of the statements in your review of the above book in NATURE of April 24 are inaccurate.

"Great explosions do not, as Dr. Harger imagines, travel either exclusively or generally against the direction of the ventilating currents." What I say in the book (p. 78) which your reviewer is presumably criticising is this:—"All big dust explosions are similar to the one at Altofts. Ignition is followed by quiet combustion for 50–100 yards, then the wave of progressive combustion gathers speed, and finally attains a velocity approaching that of detonation, and races through the dust and air at a speed of 50–100 miles per minute. Such dust explosions always proceed *against* the current of air; sometimes they go the other way also, but seldom reach the working faces. As a rule the branch of an ignition which travels with the air current fails to develop violence &c.

Every dust explosion in a mine on record *has* travelled against the air current, and the *reason* for this is clearly put in my paper on gob fires and the prevention of gob fires in mines, which your reviewer quotes, and also on pp. 98–100 in the book.

Your reviewer quotes Proc. Roy. Soc., vol. xxviii.,

p. 416, to show that a mixture of Ferndale dust and air is probably explosive, but the Ferndale dust mentioned in my papers and book is from the anthracite seams, and it is generally admitted now that anthracite dusts and air are *not* explosive *when unmixed with firedamp.*

I think readers of NATURE will agree that it is not permissible to quote half a paragraph when the rest of it amplifies. JOHN HARGER.

Chemical Laboratory, Liverpool University.

WE take exception to Dr. Harger's statements, in the quotation which he gives from p. 78 of his book, that "dust explosions" such as Altofts "always proceed *against* the current of air," and that, "as a rule, the branch of an ignition which travels with the air-current fails to develop violence."

The explosion at Altofts travelled to a distance of more than a mile in No. 1 chain road in the same direction as the air current had been previously travelling, and produced a greater amount of wreckage in that heading than in any other part of the mine. It did not reach the faces at any point, nor did it enter the return airways, for the reasons plainly set forth in Proc. Roy. Soc., vol. xlii., p. 174.

In our experience explosions are invariably found to have penetrated into the faces wherever there has been an uninterrupted train of coal-dust leading to them; and they have, as a rule, failed to pass through the return airways where the latter have not been recently used as haulage roads, and where, consequently, the coal-dust has become mixed with a large proportion of shale dust. For instance, the composition of a sample of dust taken from the return airways at Altofts Colliery after the explosion was as follows:—

	Per cent
Moisture	4·40
Volatile matter other than moisture ...	10·37
Carbon (estimated)	15·64
Ash	69·59

The experiments since made, both at Altofts and Liévin, have shown that dust of this quality is incapable of propagating an explosion.

The reference to Proc. Roy. Soc., vol. xxviii., p. 416, in the review, was not intended to show that a mixture of Ferndale dust and air "*is probably explosive,*" as Dr. Harger suggests, but that return air does not contain too little oxygen or too much carbon dioxide to prevent its ignition when mixed with coal-dust even of the same quality as that of Ferndale. There are no anthracite seams in Ferndale Colliery; all the seams consist of steam coal of high-class quality. THE REVIEWER.

Error in the Smithsonian Physical Tables.

I HAVE just discovered a very awkward error in Table 47, p. 35, of this valuable publication. The table is headed "Least Squares," and gives the values of the probability integral. To illustrate the error, an example will be best.

For argument 0·53, the table gives 0·55494, but this is really the value for the argument 0·54, and the same error runs throughout the table. An easy way to correct it is to increase by 0·01 each of the figures in the horizontal line heading the table.

My copy is dated 1896, and I do not know if the mistake has been set right since.

I am reminded that some years ago I wrote to NATURE to suggest that all discovered errors in tables should be sent to some official scientific body, which should annually publish corrections of them.

C. T. WHITMELL.

Hyde Park, Leeds, May 22.

ANTHROPOLOGY IN WEST AFRICA.[1]

WE welcome a report by Mr. N. W. Thomas on the people of the Awka district, Ibo country, Southern Nigeria. Mr. Thomas is the Government anthropologist and has already given us an interesting report on the Edo-speaking people.

The present report is divided into three parts; the first treats of the law and customs of the people, the second is a dictionary, and the third contains proverbs, narratives, and vocabularies.

The most interesting to the general reader is undoubtedly part i. In chapter ii. Mr. Thomas gives some most interesting demographic facts and figures. Referring to infanticide, he says:—

> In addition to this legal infanticide (the exposure of twins) . . . I have more than once heard that the first-born of every woman is killed; my informants were Roman Catholic missionaries, who certainly know the native and his ways, and my own statistics seem to bear out the statement.

This is very interesting, and bears out the principle common, evidently, to most West Africans, that the first-born belongs to the owner of the family (*i.e.* the dead father). He, as head of the family, is worshipped by his son, grandson, great-grandson, and great-great-grandson. He (the dead one) has need of followers in dead man's land, and claims this toll in exactly the same way as the owner of a goat will claim its first-born from the farmer who is looking after it for him.

The genealogical tables are of great interest, and, in spite of the fact that the number of wives to one husband varies from four to eight, "the proportion of boys to girls in the births was fifteen to eleven." But there are more grown-up females than males. Taking the statistics for living males and females among the Ibo (1218 males to 1340 females), we can only conclude that the mortality among boys is greater than among girls or that this majority is largely composed of widows. That husbands in such a country should have four to eight wives must deprive a great number of men of the luxury of a wife. Many chiefs tacitly acknowledge this want and have appointed females in each town or village to supply the need. But in spite of this precaution young bachelors are constantly committing adultery. Men with one wife in this district account for 760 male and 787 female children, men with four wives for 137 male and 113 females. This chapter is most instructive to those who are interested in the question of polygamy *versus* monogamy.

Chapter iii. is entitled "Religion," and, written by such a master of anthropology as Mr. Thomas, is a lesson to all students of religion in Africa. Those of our readers who have followed the development of this great colony will not have forgotten the suppression of the so-called juju at

[1] "Anthropological Report on the Ibo-speaking Peoples of Nigeria." By N. W. Thomas. Part i., Law and Customs of the Ibo of the Awka Neighbourhood, S. Nigeria. Pp. 161+xx plates. Part ii., English-Ibo and Ibo-English Dictionary. Pp. vii+391. Part iii., Proverbs, Narratives, Vocabularies, and Grammar. Pp. vi+199. (London: Harrison and Sons, 1913.)

Aro Chuku and the recent recrudescence of the horrible rites nipped in the bud by the District Commissioner. Mr. Thomas writes: "We have,

FIG. 1.—Mauri. From "Anthropological Report on the Ibo-speaking Peoples of Nigeria."

it is true, at the head of the pantheon a supreme god known as Cuku," who "seldom appears to figure in creation myths." The old men say that they knew nothing of Cuku before the coming of the white man. This may be quite correct, for our experience is that the idea of a supreme god is seldom reached by people living in the clan stage. To have a god like the Yoruba Olorun, or the Bini Osalubwa, people must have reached the kingdom stage of development. If the Aro Chuku juju had not been suppressed it is possible that the Ibos would be well on their way in their development of a great Ibo kingdom under the supreme god Chuku. It is rather remarkable that a trained anthropologist like Mr. Thomas should call the chief of Uri king in his chapter on priestly kings. The father of the family prays for his people, the head of the house does the same, the elected judge or head of a number of clans, or a tribe, does the same. The priestly office is there, but surely not kingship. At any rate, if the chief of Uri is not yet a king, it would appear that he, as a great spiritual leader, is on his way to kingship if his progress is not interfered with.

It is impossible to do justice to this part of Mr. Thomas's report in the space available. All his chapters are intensely interesting.

Part ii. is the dictionary, the material for which was, Mr. Thomas says, collected in 1911 from natives of Awka and Onitsha. It seems a pity that the vast and interesting material collected by the various missionary societies has not been taken into account. They must have dictionaries, at any rate in manuscript, and they have made translations in the Ibo language. We notice that Onitsha is spelt Oniča, and that Mr. Thomas, instead of adopting the geographical system of spelling as officially gazetted, has given us a system of his own—a good one, no doubt, but a new one. There are thus three systems of writing in Nigeria—the system adopted by the missionaries, the system enforced on officials by the Government, and Mr. Thomas's system.

Mr. Thomas has shown his caution by omitting the words "God" and "Čuku" from his dictionary.

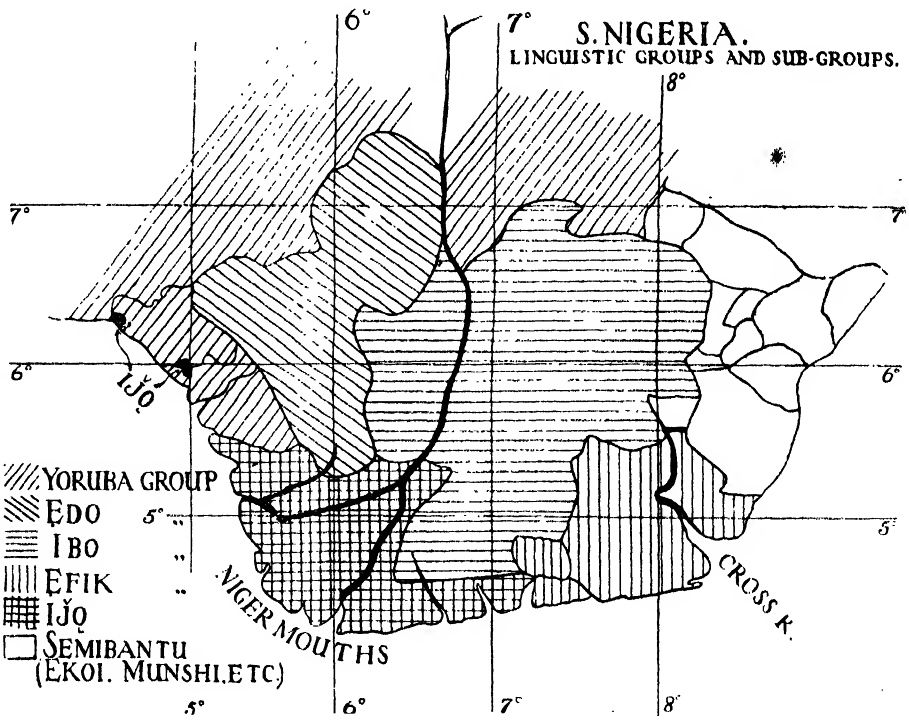


FIG. 2.—From "Anthropological Report on the Ibo-speaking Peoples of Nigeria."

There are no words beginning with the English *c* sound in the dictionary, and all the words under *č* in the dictionary are to be pronounced *tch*, or as the *c* in "church." Why, then, should not the simple *c* stand for this sound? The new *č* seems unnecessary.

The letter *j* is to be pronounced as *j* in "judge," but it is to be written *ĵ*. In the Yoruba dictionary the sound *sh* is written *ṡ*. This sign, Mr. Thomas says, stands for the cerebral *s*, and he writes the *sh* sound *š* instead of *ṡ*. There will be great gnashing of teeth in Nigeria until the Government takes the matter up and appoints a commission to settle which system is to be maintained.

Part iii.—Needless to say, Mr. Thomas has treated the proverbs, narratives, and grammar scientifically. The folklorist will revel in them. The student of the Ibo language will be greatly helped by the literal translations of the stories and by the vocabularies.

Mr. Thomas divides the languages in Southern Nigeria into four groups.

(*a*) Yoruba with Igara and Šekri (Jekri).

(*b*) Edo (Ado), including Sobo, Bini, Kukuruku, and Esa (Ishan).

(*c*) Ibo with Ika and numerous other languages.

(*d*) Efik and Ibibio.

The Government of Southern Nigeria is to be congratulated on the production of these valuable reports by its Government anthropologist, and we hope that Mr. Thomas will soon give us equally interesting books about the Ibibios and Efiks.

THE INTERNATIONAL ASSOCIATION OF ACADEMIES.

THE fifth meeting of the International Association of Academies was held at St. Petersburg during Whit-week. Of the twenty-two academies which constitute the association, twenty-one took part in the proceedings, the British Academy being the only society which was not represented. The delegates of the Royal Society were: Sir David Prain, Prof. Arthur Schuster, Prof. Sherrington, and Prof. Turner.

Among the new proposals the most important was that submitted by the Berlin Academy for an international investigation of the problems connected with volcanoes. It is not intended to form an international institute similar to that for geodesy or seismology, but rather to encourage each country to take its share in the investigation by establishing, if desirable, a separate institute of its own. An autonomous commission of the International Association of Academies could then act as connecting link between the different institutions. A small committee was nominated to make more definite proposals to the next assembly, and was authorised to enter into communication with the separate academies, each being asked to nominate a representative, and thus form a larger body to assist the committee in formulating a scheme of joint investigation.

An interesting proposal came from the Imperial Academy of St. Petersburg. The want is apparently felt in several branches of science to have a more scientific scale and definition of compound colours than exists at present. It ought to be possible to define the colour, *e.g.*, of a particular leaf, the skin of an animal, or a new chemical compound in such a way that everyone could obtain an accurate idea of it. Books, containing numbered samples of the different shades of the various colours, suffer from the defect that they are subject to change; and though in practice it may be found necessary to use such books as secondary standards, some means should be found to compare them from time to time with a more scientific scale of colours. The committee appointed to discuss this question consists of: Prince Galitzin, Sir Wm. Abney, and Messrs. Nasonow, Saccardo, Schuster, and Walden.

It has become the habit of the association to give its moral support to undertakings which it considers valuable; such support often enabling those more directly interested in them to obtain from other sources the financial help they need. A proposal to encourage in this fashion an organisation instituted at Frankfort by Prof. Brendel for calculating the orbits of small planets was adopted on the motion of the Académie des Sciences of Paris.

An enterprise to publish annually a table of physico-chemical constants had already been supported at the meeting at Rome; and though the utility of the work was subjected to some criticisms, it appeared that there was a real demand for it, and it received renewed support at the present assembly.

A report was presented by Prof. Turner on the progress of the work connected with the nomenclature of features on the surface of the moon. Although the committee has suffered much through the deaths of Prof. Franz and Mr. Saunders, there is good hope that the work will soon be completed and prove a most useful help to students of lunar phenomena.

A question of wider interest was raised by the French proposal to discuss the possibility of a reform of the calendar. This includes not only the question of fixing the date of Easter, but also more sweeping changes intended to divide the year into four equal quarters (at present the first six months consist of 181 and the second six months of 184 days) and the intercalation of an occasional extra day in the week, introduced to secure that the same day in each year should always be associated with the same day of the week. A committee was appointed to consider this matter.

The above, referring entirely to the work of the section of science, does not exhaust the questions which were raised and discussed before that section. The section of letters also had a successful meeting.

The association is still young, and consequently has to devote some attention to the statutes and regulations for its procedure, which have not yet become crystallised. A proposal to appoint a permanent secretary was strongly supported by some and opposed by other academies. It will

come up for decision at the next meeting, which will be held three years hence in Berlin, after discussion by a standing committee charged with the general revision of the statutes.

Proposals to elect the Royal Society of Edinburgh and the Finnish Academy of Helsingfors as members of the association were presented by the Royal Society of London and the Imperial Academy of St. Petersburg respectively. As several of the delegates were without definite instructions from their academies, the proposals will have to be submitted to the constituent bodies and voted upon by correspondence.

It is needless to say that the social functions of the meeting were carried out admirably and with lavish hospitality. Dinners and evening parties followed each other almost too continuously, and the ladies accompanying the delegates will not forget the manner in which they were hospitably entertained throughout their stay in St. Petersburg. But this account is only intended to deal with the scientific aspect of the meeting, and a brief reference only can therefore be made to the visit to the Tsar's palace at Tsarkoé Sélo, during which the delegates were individually presented to the Emperor of Russia and afterwards entertained at luncheon.

ARTHUR SCHUSTER.

PROF. JAMES GORDON MACGREGOR, F.R.S.

PROF. J. G. MACGREGOR, of Edinburgh University, died suddenly and unexpectedly on the morning of Wednesday, May 21, shortly after he had risen, apparently in his usual health. It was known, of course, both to himself and his friends that his heart was not in the healthiest condition, but up to the moment of his death no really grave symptoms had declared themselves.

Prof. MacGregor was born on March 31, 1852, at Halifax, Nova Scotia, where his father had been a well-known clergyman. He early showed mental abilities of a high order; and in 1871 he graduated M.A. at Dalhousie College, Halifax, with the highest distinctions in all departments. He was awarded the Canadian Gilchrist scholarship, the condition of which required him to continue his studies and take a degree in London University. He decided to follow out physical and chemical science, and in 1871 entered himself as a student of science in the University of Edinburgh. He began what promised to be a most distinguished career; but unfortunately he broke down in health and was forbidden to work for competitive honours in the classes. During his second winter he spent much of his time in Prof. Tait's laboratory, and in conjunction with Ewing (now Sir Alfred) he measured the electrical resistance of certain saline solutions. The paper was soon afterwards published in the Transactions of the Royal Society of Edinburgh, and it may be regarded as giving the impulse which led MacGregor to follow up the line in which his best original work was done.

He spent the better part of two years in Leipzig in the laboratory of Gustav Wiedemann, and carried out some investigations in the electrical resistance of stretched silver wires. He gained his doctorate of science in 1876, and was immediately thereafter recalled to his native town as lecturer in physics in Dalhousie College. This he held for only one year, and from 1877 to 1879 he filled the important post of physical science master in Clifton College. The tragic death, as the result of a shooting accident, of one of the Clifton College masters, beside whom MacGregor was sitting at the moment of the accident, seriously affected his health at the time, compelling him to stop work entirely for several months. Meanwhile the Dalhousie College lectureship had developed into the Munro chair of physics, and MacGregor, undoubtedly their most promising alumnus, was invited to become professor. For twenty-two years he filled this post to the educational advantage of his native town. He took an active share in the founding of the Royal Society of Canada, in the Transactions of which some of his most important papers are published. He also keenly interested himself in the welfare of the Nova Scotian Institute of Science.

In 1887 MacGregor brought out a text-book on kinematics and dynamics (Macmillan and Co.). At the time of its publication it occupied an intermediate position between the elementary text-books and the treatise of Thomson and Tait, whose methods, indeed, MacGregor largely followed. The book had outstanding merits, and covered not only what is ordinarily understood by dynamics, but much also of hydrodynamics and elasticity. In 1909 appeared a third edition, considerably altered and improved.

The writing of this book turned MacGregor's mind to the difficult question of the foundations of dynamical science; and his conclusions were given in several papers, some of which appeared in the Transactions of the Royal Society of Canada and others in the *Philosophical Magazine*. These are characterised by clearness of apprehension of the questions at stake and by a logical statement of his own views.

On the retirement of Prof. Tait in 1901 from the chair which he had filled with such conspicuous success for forty years, Prof. MacGregor was elected his successor. During the twelve years of his tenure of this post MacGregor's chief work outside the ordinary duties of his chair was to develop the natural philosophy department and bring it into line with modern requirements. The transformation of the old infirmary building into a well-equipped laboratory demanded a vast amount of detailed consideration; and after two years of careful planning the new department was opened in 1907, not in the completed state designed by MacGregor, but sufficiently developed for a start to be made. With later additions and developments the whole combined departments of natural philosophy and applied mathematics remain as a lasting monument to Prof. MacGregor's energy, zeal, and forethought.

During the last few years Prof. MacGregor had been actively engaged in appealing to Prof. Tait's

old students for subscriptions towards a new chair on the mathematical side of natural philosophy, to be called the "Tait Chair."

Prof. MacGregor's original contributions to scientific literature other than those already indicated are mainly concerned with electrical conduction, ionisation, densities, and freezing-point depressions of solutions. These are published chiefly in the Transactions and Proceedings of the Royal Society of Canada, the Royal Society of Edinburgh, and in the *Philosophical Magazine*. He also wrote interesting addresses on educational subjects of a more general nature, and a few years ago published for the use of the students a pamphlet on physical laws and observations.

Prof. MacGregor was an enthusiastic teacher, and spared neither time nor trouble for the sake of his students. His accessibility endeared him to all. Busy though he was at all times, he was ever ready to lay aside his personal work, however pressing, so as to discuss any difficulties his students might have. His was a sunny, genial nature, finding pleasure in ministering to the needs of others; and there was no trouble too great which he would not take on behalf of his friends.

C. G. KNOTT.

NOTES.

WE regret deeply to announce that Lord Avebury died on May 28, at seventy-nine years of age.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 7.

THE Croonian lecture of the Royal Society will be delivered by Dr. Robert Broom on Thursday, June the subject will be "The Origin of Mammals."

WE learn from the *Revue Scientifique* that the mathematical works of the late Henri Poincaré are to be published by the firm of Gauthier-Villars, under the auspices of the Minister of Public Instruction and the Paris Academy of Sciences.

AT the meeting of the Royal Meteorological Society on Wednesday, May 21, Dr. V. F. K. Bjerknes, professor of geophysics in the University of Leipzig, and Dr. Hugo Hergesell, president of the International Commission for Scientific Aëronautics, Strassburg, were elected honorary members of the society.

THE American Association for the Advancement of Research by Women has awarded the Ellen Richards prize of 1000 dollars to Dr. Ida Smedley (Mrs. MacLean) for her work on the biochemical synthesis of fatty acids. The prize is offered biennially, and was last awarded in 1909, when the successful candidate was also an Englishwoman, Dr. Florence Buchanan.

THE fourth International Congress for the Hygiene and Salubrity of Dwellings is to be held at Antwerp on August 31–September 7. The congress will be divided into four sections: the hygiene of emigrants, colonial hygiene, hygiene of ports and ships, and the development of towns from the hygienic point of view. Persons desiring to take part in the congress should communicate with the treasurer, Mr. A. Cols, notary, Willem Tell Street, 3, Antwerp.

THE president of the Royal Society has received from the Portuguese Legation subscriptions amounting to 21*l*. 5*s*. forwarded by the Society of Medical Science of Lisbon as a donation to the Lister Memorial Fund. A sum of 867 dollars has been collected by Dr. W. W. Keen, of Philadelphia. Further donations intimated from foreign countries include:—University of Paris, 500 francs; University of Lyons, 100 francs; Société de Chirurgie of Lyons, 100 francs; faculty of medicine of the University of Munich, 100 marks; faculty of medicine of the University of Breslau, 110 marks; and Stockholm Medico-Chirurgical Society, 5*l*. A donation of 10*l*. has been received from the University of Calcutta.

WE are glad to be assured by Prof. Sampson, Astronomer Royal for Scotland, that the damage to instruments due to the explosion of a Suffragette bomb at the Royal Observatory, Edinburgh, on May 21, was happily insignificant. The bomb was placed on the floor below that of the west dome. The floor of the west dome is a heavy one, and thoroughly protected the 24-in. reflector and Cooke photovisual above it. The driving clock for these telescopes was near the bomb, but appears uninjured except in respect to its glass case. On the floor below falling plaster smashed the glass case of the Cooke drum chronograph, which is at present out of use. The disturbance was recorded by the Milne seismograph at 0h. 57·2m. as a small, sharp oscillation of approximately 0·1″ semi-amplitude.

SINCE 1908 the Somersetshire Archæological and Natural History Society has engaged in excavation work at Glastonbury Abbey, and year by year results of great historical and archæological importance have been secured. Last year, the society, at the request of the Abbey trustees, appointed a special committee to undertake the supervision of the future excavation work, and the researches will proceed systematically. An income of 250*l*. a year is needed to carry out the work efficiently, and the funds hitherto raised by subscriptions and donations are exhausted. The committee now makes a further appeal for money. Subscriptions or donations may be sent to the treasurer of the Glastonbury Abbey Excavation Fund, The Castle, Taunton, Somerset.

AT the annual meeting of the Royal Geographical Society on Monday last, in addition to the presentations made to Lady Scott and Mrs. Wilson of the awards voted to their husbands, who died in the Antarctic, and that made to Lieut. Campbell, which are referred to elsewhere, the following awards were made:—The Victoria medal to Col. S. Burrard, Surveyor-General of India; the Murchison award to Major H. D. Pearson, for his work in the Sudan; the Gill memorial to Miss Lowthian Bell (Mesopotamia, &c.); the Cuthbert Peek grant to Dr. Felix Oswald (Armenia); and the Back bequest to Mr. W. S. Barclay (South America). In his anniversary address, Earl Curzon, as president, referred to the momentous events of the past year in polar exploration, and made the interesting announcement that the society expects presently to receive into its charge

Scott's diary and some of Dr. Wilson's beautiful water-colours. He mentioned the important work projected in the Arctic by Amundsen, Stefánsson, and Macmillan, and briefly reviewed geographical work elsewhere. He had naturally a good deal to say on the new establishment of the society at Kensington Gore, viewed with optimism the important bearing which the better conditions under which the society will now work should have on the progress of geographical study in this country, and discussed the new meeting-hall which he clearly expects to see built. At the annual banquet in the evening, Sir E. Grey and Lord Milner, among the speakers, both testified emphatically to the importance of geographical teaching and study, in relation to the maintenance of empire, on their now broadened basis of the bearing of physical conditions upon human activities.

THE annual congress of the Royal Institute of Public Health was held in Paris, May 14–19, Prof. W. R. Smith, the principal of the institute, presiding. Important papers on tuberculosis were contributed by Prof. Delépine ("Milk-borne Tuberculosis") and Dr. Lister ("The Future of State Campaigns against Tuberculosis"), who considered that the future of campaigns against the disease was a matter more for the social reformer than for the public health officer. Mr. L. Gaster lectured on artificial illumination, making many useful suggestions on the nature of the illuminant to be employed and its methods of use. Dr. Bertillon arranged an exhibit showing the mortality in a number of trades and employments, contrasting those of Great Britain with those of France and one or two other countries. The members of the congress were most cordially received, and visits were arranged to all the important institutions, municipal and public, factories, and so on. The Harben gold medal of the institute for 1912 was presented to Dr. Roux, of the Pasteur Institute.

THIS year the Société Helvétique des Sciences Naturelles will hold its meeting at Frauenfeld on September 7–10. Among the lectures announced already the following may be mentioned:—Prof. Grubenmann, of Zurich, "Ueber die Entwicklung der neuern Gesteinslehre"; Prof. Fuhrmann, of Neuchâtel, "Voyage d'études scientifiques dans les Cordillères de Colombie"; Dr. de Quervain, of Zurich, "Die Durchquerung Grönlands durch die schweizerische Expedition und deren Ergebnisse"; Prof. Keller, of Zurich, "Die Tiergeographie des Kaukasus"; Prof. Maillefer, of Lausanne, "Les lois du géotropisme"; Prof. Rikli, of Zurich, "Pflanzengeographische Studien über die Kaukasusländer"; and Prof. Dutoit, of Lausanne, on a subject of physical chemistry. On September 9 the Swiss mathematical, physical, chemical, geological, botanical, and zoological societies will also hold their annual meetings at Frauenfeld. A number of attractive excursions have been arranged for visitors. Persons desiring to attend the meeting of the Swiss Association should communicate with M. A. Schmid, president of the committee, at Frauenfeld.

THE Board of Agriculture and Fisheries has issued a circular intimating that numbers of salmon smolts and kelts have been "marked" in various rivers, by means of a wire, or a wire and label, attached to the dorsal fin. Rewards will be paid for the return of these marks, accompanied by the particulars of sex, length, weight, and condition of the fish to which it was attached, and by a few scales taken from the body of the fish behind the gill-cover. The object of these experiments is to trace the migrations of the fish, mainly the length of the period spent in the sea. The object of the removal of the scales is to determine, from a microscopical examination of the latter, the age of the fish and its history as regards sexual maturity and previous spawning acts. Anglers and others interested in the study of the salmon will welcome the instigation of these experiments by the Board. Investigations of a similar kind have been made so far mainly by private persons in this country, but with the resources at the command of the Board very valuable results should be obtained. The investigation is, of course, one which depends for its success upon the cooperation of sportsmen and fishermen, and we cordially recommend that this assistance be rendered.

ON May 23 a communication was made to the Hon. Society of Cymmrodorion, by Mr. T. A. Acton and Mr. W. Burton, descriptive of the excavations that have been conducted during the last three years at Holt, near Wrexham. Mr. Acton has discovered the site of a tile and pottery works of the twentieth Roman Legion, and he gave a review of the discoveries of the foundations of buildings for housing the workers and probably the garrison of what must have been practically a frontier post, and also of the excavations of a series of potters' kilns. Thousands of fragments of Roman tiles and pottery have been excavated from the site, and are now in process of classification. Mr. William Burton explained the construction of the kilns, which are fortunately so well preserved that the leading features of the construction of both the circular and rectangular kilns used by the Romans in various parts of the empire are now clearly established; they foreshadow in a remarkable way the main principles of modern kiln construction. Mr. Burton exhibited three models of different types of kilns made from careful measurements of the remains, and these will be deposited ultimately in the British Museum.

THE census report of the Nicobar Islands for 1911, just published, gives a good example of the custom of Couvade or "hatching." For some days or even weeks before the wife's confinement, the people in the hut, as a form of sympathetic magic, unloose all the cane and fibre lashings of their spears or vessels. During the first month after the birth of his first child the father is treated as an invalid. On subsequent occasions this lasts only one or two days. He is looked after and fed by his wife, and may not bathe or chew betel. These rules, which are enforced by the Menluanas, or medicine-men, are so irksome that it is believed their observance accounts for a widespread avoidance of maternity among the women.

THE classical account of the pagan tribes of the Malay Peninsula by Messrs. Skeat and Blagden is being gradually supplemented by later inquiries among this interesting people; but these investigations only serve to prove the correctness of the earlier record. Mr. L. H. N. Evans now publishes in the Journal of the Federated Malay States Museum, which takes the place of the Perak Museum Notes, an account of the Besisi of Tamboh, Kuala Langat, Selangor. Their advance in culture is illustrated by the fact that they are now able to ride bicycles, which they borrow from the Chinese. Mr. Evans made a considerable ethnographical collection, including specimens of two methods of fire-making—by the saw and drill—which are being replaced by the use of matches and the flint and steel. As an example of culture contact, two ingenious forms of animal traps are now found in use from Nepal and Assam eastward through Indo-China and the Malay Peninsula, and all over the Greater Sunda Islands.

THE researches that are being carried out at the present time, with so much patience and minuteness, upon disease-producing parasites, though undertaken primarily with practical aims in view, are helping to accumulate in many cases data of great value from a purely scientific and theoretical point of view. It is becoming, for example, increasingly evident that the pathogenic trypanosomes represent a group of incipient species in process of coming into being, in many cases differentiated physiologically, but not morphologically. From this point of view the human trypanosome generally known as *Trypanosoma rhodesiense* is very interesting. It is possible that it is an old-established species lately discovered; but it is far more probable that it has become but recently differentiated, and that it represents either a race of *T. brucii* that has acquired the power of living in human blood, or a race of *T. gambiense* adapted to transmission by *Glossina morsitans*. The former view has been advocated by Bruce and his colleagues, of the Royal Society's commission working in Nyasaland; but Stephens and Fantham, in a paper in the Annals of Tropical Medicine and Parasitology (vol. vii., No. 1), find it difficult to distinguish between *T. rhodesiense* and *T. gambiense* by means of measurements. The chief distinctive character of *T. rhodesiense* is the presence of the so-called posterior nuclear forms, which are studied by Blacklock in a memoir in the same journal; these forms have been found, however, in other species of trypanosomes, including *T. brucii*.

WE have received a report by Prof. E. C. Starks, issued in the Leland Stanford Junior University Publications, on the fishes collected by the second Stanford expedition to Brazil, in which several species are described as new. A report has also reached us on the fishes of certain tanks in Bengal, drawn up by Mr. T. Southwell and Capt. R. B. S. Sewell, and published at Ranchi by the Bihar and Orissa Department of Agriculture.

THE March issue of the Proceedings of the Philadelphia Academy contains a report on parasitic worms infesting the animals in the local zoological gardens. The average number of infestations is about forty-five per annum, but in 1910 there was a rise, due to the prevalence of cestodes in birds, while a second rise, owing to nematodes in parrots and perching birds, occurred in the following year. Among mammals Carnivora are much more heavily infested than any other order, monkeys, ungulates, and marsupials making nearly a dead-heat for second place. The new observations confirm previous statements that nematodes are the most common parasites, these being followed by cestodes, flukes, and Acanthocephali, in the order named.

IN *The American Museum Journal* for March Mr. Barnum Brown describes, with a good series of photographs, the discovery at Red Deer River, Alberta, of a new crested dinosaur, now named Saurolophus, "the crested saurian." In life this animal was about 32 ft. in length, and stood about 15 ft. in height when erected. Like Tracodon, it was a herb-eater, and unable to defend itself from the contemporary flesh-eating Albertosaurus, except by its power of escaping danger by swimming. Great numbers of these creatures lived in the prehistoric coastal marshes, and in a single quarry on the Red Deer River bones of several hundred individuals, mostly of this kind, have been washed out of the bank. Another set of bones discovered in the same district represents the skeleton of another new dinosaur coming from an older formation, and probably an ancestor of Saurolophus.

THE first of a series of studies on the evolution of the teeth of primates, by Dr. L. Bolk, professor of anatomy in the University of Amsterdam, has been published (G. Fischer, Jena, 1913, price 5 marks). A completely new interpretation is given of the relationship between milk and permanent teeth. We have hitherto regarded them as belonging to different epochs of evolution—the milk teeth representing a primary dental outfit, the permanent a secondary acquisition. Prof. Bolk, from a prolonged inquiry into the developmental stages of the teeth of reptiles and mammals, has accumulated evidence to show that both reptiles and mammals have arisen from a stock which was furnished with three rows of teeth, all of which came into use at the same time. In both reptiles and mammals the outer row is represented by vestiges—the so-called pre-lacteal dentition. In reptiles the middle and inner rows persist and come into use together. In the higher or diphyodont mammals the middle rows come into use first, forming the milk dentition, while the inner is delayed in its appearance, and forms the permanent set of teeth. In lower or monophyodont mammals both middle and inner rows of teeth—that is to say, milk and permanent teeth—come into place and use together, forming an apparently linear series. Prof. Bolk's hypothesis promises to simplify our conception of the evolution of mammalian teeth, and explains many facts which were formerly obscure.

MR. W. ENGELMANN, Leipzig, has lately issued parts 55, 56, 57, and 58 of "Das Pflanzenreich." This magnificent *regni vegetabilis conspectus* is making rapid progress, though up to the present time only one group (Sphagnaceæ) of cryptogamous plants has

been dealt with. Heft 55, by Prof. Engler, begins the account of the Philodendroideæ section of the large family Araceæ by Engler and Krause, and is unusually well and fully illustrated with new figures. Heft 56, by Dr. F. Kränzlin, forms a self-contained monograph of the "Indian shot" family, Cannaceæ, and concludes the treatment of the interesting order Scitaminales, the remaining three families of which (Musaceæ, Zingiberaceæ, Marantaceæ) have already been described by Schumann; in his introduction the author gives an account of the various interpretations which have been put forward of the structure of the outer floral organs in Canna, the sole genus in the family. In Heft 57, Dr. Pax, assisted by Käthe Hoffmann, continues the monograph of the large and difficult family Euphorbiaceæ; in addition to figures of many of the species, there is given a useful table showing the geographical distribution of the genera belonging to the section (Chrozophorinæ) dealt with in this part. Heft 58, by G. Grüning, gives the Stenolobeæ section of the same family.

WE have received a copy of vol. xlviii., No. 8, of the Proceedings of the American Academy of Arts and Sciences, consisting of an extensive memoir by Mr. J. W. Hotson on culture studies of fungi producing bulbils and similar propagative bodies. In this paper the author brings together the scattered references in mycological literature to the occurrence in various fungi of these propagative bodies, which are cell-masses ranging from spore-like structures to large sclerotium-like forms, and indeed shading gradually into these two definite and distinct types (spore and sclerotium) of reproductive body. After describing in detail, with numerous excellent figures on twelve plates, the structure and development of bulbils in the various species examined during his long-continued culture experiments, the author discusses the morphological significance, distribution, and occurrence of bulbils in fungi. He concludes that in most cases, if not in all, these bodies are not to be regarded as abortive spore-fruits (ascocarps), but rather as an auxiliary method of reproduction that has been interpolated in the life-history of certain fungi without definite relation to other methods of reproduction they may possess, or that if they have in reality been derived from some other reproductive body, this was more probably some form of non-sexual spore rather than the primordium of an ascocarp.

THE Memoirs of the Indian Meteorological Department, vol. xxi., part 7, contain an interesting inquiry into the cold weather storms of northern India by Dr. G. T. Walker and Rai Bahadur Hem Raj. It is pointed out that the storms in question, which occur between December and April, are of considerable agricultural importance, and that it is extremely desirable that their origin should be ascertained, the view that these rain-bearing disturbances are generated over the arid districts of Persia and Baluchistan being by no means free from difficulty. An examination of charts recently prepared by the Meteorological Service of Egypt for the years 1906–12 shows that about seven-tenths of the disturbances which affect north-west India in those months are continuations of depressions from southern Europe, but the paths of the depressions vary considerably from year to year. In order to confirm the origin of most of the storms without a large expenditure of labour in preparing charts, Dr. Walker had recourse to statistical methods. He says that if these storms pass over Syria or Asia Minor it is to be expected that severe winters with much precipitation in these areas will tend also to be severe winters in north-west India. "A calculation was accordingly made of the correlation coefficients of the seasonal rainfall in north-west India with those of rainfall in places to the west for which records were available." The evidence shows that the winter seasons in the west of Asia Minor, in Syria, and in Malta have a closer resemblance to those of north-west India than do the winter seasons of Persia and Mesopotamia.

IN his presidential address to the Institution of Mining and Metallurgy, delivered on March 13, a copy of which has just reached us, Mr. Bedford McNeill devoted his attention more particularly to the statistics of production of the more important metals, laying especial stress upon the precious metals. He showed that the production of metals was increasing at a rate quite unexampled in the history of the world, the percentages of increase during the decade ending in 1911 ranging from 29 in the case of lead up to no less than 513 for aluminium, whilst it was 58 for iron and 68 for copper. The metal miner is therefore supplying the world with the metals used in the arts upon an enormously greater scale than ever before. As regards the precious metals, it is shown that within the above-named decade the production of gold has increased by 79 per cent., and that the world's annual output of gold is now more than equal to the total production for the sixty years preceding the year 1700. Mr. McNeill shows that this increase of production is to some small extent counteracted by the remarkable absorption of gold that has been taking place for some years past in India, and to a smaller extent also in Egypt. The production of silver has also undergone an increase, though less than gold, the increase during the decade 1901–11 being 41 per cent.; the actual production of silver during that period was ten times as great as that of gold, though this proportion is one that appears to fluctuate considerably from time to time.

WHEN our knowledge of the mean depth of the oceans was less extensive than it is now, it was supposed that a close approximation along certain lines was given by the velocity of seismic sea-waves. The formula (Lagrange's) used for the purpose was $v=\sqrt{(gh)}$, where v is the mean velocity of the waves and h the mean depth along the line of ocean traversed by them. It was shown, however, by Dr. Davison (*Phil. Mag.*, vol. xliii., 1897, pp. 33–36) that, when the depth is variable, the formula gives too great a depth, and that it should be $v = s \Big/ \int \frac{ds}{\sqrt{(gh)}}$, s being the distance from the epicentre. Prof. Rudski ("Physik der Erde," 1911, p. 340) suggested the formula $v=\frac{1}{s}\int \sqrt{(gh)}ds$. Prof. G. Platania has recently made a comparison of the results given by the three

formulæ in the case of the Calabrian earthquake of October 23, 1897, the sea-waves of which were registered by the mareographs at Messina and Catania (*Boll. Soc. Sism. Ital.*, vol. xvi., 1912, pp. 166–174). The actual mean velocity was 102 metres per second, while the values given by Davison's, Rudski's, and Lagrange's formulæ were respectively 109, 114, and 120 metres per second.

VOL. xiii., part 2, of the Proceedings of the Nova Scotian Institute of Science contains an account, by Mr. J. H. L. Johnstone, of measurements of the specific resistance of ice at temperatures between 0° and −19° C., made by a new method, in which the effects of electrolytic polarisation were eliminated. The values obtained agree fairly well with those obtained by Profs. Ayrton and Perry, using a different method, and show that the value of the temperature coefficient is very much higher than that of ordinary electrolytes and decreases in value as the temperature departs from 0°. The same number of the Proceedings also includes an interesting account of the sacred trees of India, by Capt. J. H. Barbour.

WE have received a copy of the reprint of the Carnegie Institution of Washington paper on the magnetic survey work in southern and central Africa carried out in 1908 and 1909 by Prof. Beattie, of the South African College, Cape Town, and Prof. Morrison, of Victoria College, Stellenbosch, who for the time necessary were made officials of the Carnegie Institution. The cost of the work was defrayed by the Carnegie Institution, 2000*l*., the Royal Society, 250*l*., and Sir L. S. Jameson and Sir L. Mitchell, 100*l*. The survey covers the regions between the Zambezi and the Nile, including parts of north-eastern Rhodesia, the Congo, German East Africa, Uganda, Nyasaland, and British East Africa, with further observations in Cape Colony and German South-West Africa. Throughout most of the journey the only means of conveyance was by native carriers, and the history of the expedition reads like a chapter of Livingstone's travels. We offer our congratulations to Profs. Beattie and Morrison on the successful accomplishment of an important and much-needed piece of magnetic survey work.

SEPARATE copies have reached us of a considerable number of papers which have been published by the staff of the Reichsanstalt during the present year. Dr. F. Henning has compared the platinum resistance with the hydrogen thermometer at temperatures between 0° C. and −193° C. He finds that Callendar's formula connecting the two holds only down to −40° C., and proposes another formula, which holds over the whole range. Drs. K. Scheel and W. Heuse have determined by the continuous-flow method the specific heats at constant pressure of helium, hydrogen, nitrogen, oxygen, air, and carbonic oxide, at temperatures down to that of liquid air. The specific heats of helium and hydrogen increase with increase of temperature, the others decrease. In connection with these researches a thermostat suitable for low temperatures has been devised by Dr. Henning. It depends on the passage of a stream of liquid air through a suitable liquid, as, for example, petroleum ether. The air evaporates in the liquid, and the rate of evaporation determines the temperature to which the liquid is cooled. The former papers will be found in the March and April numbers of the *Annalen der Physik*, and the last in the February number of the *Zeitschrift für Instrumentenkunde.*

IT has long been known that the photometry of sources of light widely differing in colour is rendered difficult by the peculiarities of the eye, especially at low illuminations. Until recently this was not of much practical importance, since most of our commercial illuminants yielded continuous spectra and light of substantially the same tint. Now, however, things are changed. A recent communication by Messrs. Broca, Jouast, De la Gorce, and Laporte (*Bull. Soc. Int. des Electriciens*, February, 1913) shows the perplexities likely to be met with in comparing such sources as the mercury-vapour lamp and the new neon tube. The former contains only yellow, blue, and green light, the latter only red and orange rays between 0·585 μ and 0·640 μ. The authors meet with differences of 100 per cent. or more, according to the illumination of the photometer screen. Similar discrepancies are caused by the personal errors of different observers. To these difficulties, due to the colour of the light, must be added those arising from the fact that the light is not a point, but a tube of considerable dimensions, so that the ordinary inverse square law of photometry does not apply. Another interesting observation is that objects illuminated by the neon light appear more sharply defined than in the case of ordinary illuminants. The reason would appear to be that the monochromatic nature of the light avoids the results of chromatic aberration in the eye.

SOME new experiments on the preparation and properties of pure alcohol are described in the Chemical Society's Journal by Mr. R. W. Merriman. The density of the pure alcohol was established for about forty samples as 0·80628 at 0°/4°. It was shown that freshly burnt quicklime prepared from marble is a better drying agent than metallic calcium, which produces no improvement in alcohol dried by lime. In distilling the alcohol from the lime it is necessary to reject the first and last fractions; the latter have a high density, which is attributed to partial dehydration of calcium hydroxide as the temperature of distillation rises from 80° to 100° on the water-bath.

A "NEW Iron Bacterium" is described by Mr. E. M. Mumford in the Transactions of the Chemical Society. It was discovered in the Bridgewater Canal tunnels at Wasley, Lancashire, where the water contains much iron derived from colliery pump water. The new bacterium appears to have a twofold action, an aërobic action whereby it precipitates ferric hydroxide from iron solutions, and an anaërobic action which transforms the ferric hydroxide into bog iron ore with partial reduction of the iron to a ferrous state. It is probable that the deposits of bog ore are due to this organism rather than to the higher bacteria, since the latter have not the facultative power

necessary to dehydrate and reduce the ferric hydroxide to bog ore.

THE English Ceramic Society has recently issued the twelfth volume of its Transactions, and is to be congratulated on the good work which it continues to do in furthering the application of scientific methods to so important an industry. Attention may be directed specially to a paper by Mr. A. J. Campbell in which the application of "surface combustion" to pottery practice is suggested, and to a description by Dr. W. R. Ormandy of an "Electrical Process for the Purification of Clays." This consists in partially coagulating the emulsified clay by the addition of electrolytes, and then further purifying the emulsion by passing it through a vessel containing electrodes differing in potential by 60 to 100 volts. The chief impurities are electropositive, and can thus be removed, even when present in very fine particles. The clay-substance is electronegative, and is laid down in the form of a continuous blanket $1\frac{1}{2}$ yards wide and $\frac{1}{4}$ in. thick. It is deposited in a remarkably dry state with only 18 to 20 per cent. of water, and may contain as much as 99·5 per cent. of china-clay substance.

MESSRS. J. AND A. CHURCHILL have nearly ready an English translation of the Italian work, "A Treatise on General and Industrial Organic Chemistry," by Dr. Ettore Molinari. The work of translation has been carried out by Mr. T. H. Pope, of the School of Malting and Brewing of the University of Birmingham.

AN examination of "The Social Guide, 1913," which has now been issued by Messrs. A. and C. Black, at the price of *2s. 6d.* net, shows that the editors regard some scientific meetings at least as social events. Attention is directed, for instance, to the meetings of the Royal Society, the Royal Institution, the Royal Geographical Society, and the British Association. The University Extension meetings arranged in the summer by the Universities of Oxford and Cambridge are also referred to, but, speaking generally, the matters of prominence relate to sports and amusements. The subjects are arranged alphabetically, but an index would assist reference greatly.

ERRATUM.—The term $\dfrac{\Sigma P - P.N}{\frac{N}{2}}$ on p. 279 of NATURE of May 15 should have been $\dfrac{\Sigma P - P.M}{N}$.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JUNE:—

June 1. 4h. 4m. Venus in conjunction with the Moon (Venus 4° 38′ S.).
,, 12h. 0. Mercury in superior conjunction with the Sun.
4. 0h. 25m. Saturn in conjunction with the Moon (Saturn 6° 22′ S.).
,, 16h. 4m. Mercury in conjunction with the Moon (Mercury 3° 48′ S.).
7. 4h. 40m. Neptune in conjunction with the Moon (Neptune 5° 9′ S.).
19. 14h. 26m. Jupiter in conjunction with the Moon (Jupiter 4° 47′ N.).
June 21. 8h. 8m. Uranus in conjunction with the Moon (Uranus 3° 27′ N.).
,, 13h. 9m. Sun enters Sign of Cancer—summer commences.
22. 6h. 0m. Vesta in conjunction with the Moon (Vesta 0° 31′ N.).
23. 22h. 35m. Mercury in conjunction with Neptune (Mercury 2° 11′ N.).
24. 2h. 0m. Venus at greatest distance from the Sun.
29. 5h. 5m. Mars in conjunction with the Moon (Mars 4° 51′ S.).
30. 7h. 4m. Venus in conjunction with the Moon (Venus 7° 44′ S.).

COMET 1913*a* (SCHAUMASSE).—*Astronomische Nachrichten* No. 4652 contains not only numerous observations of the comet which Mr. Schaumasse discovered, but three sets of elements and ephemerides computed by Kiess and Nicolson, Ebell, and Fayet and Schaumasse. The observations made between May 7 and 11 give the magnitude between 9·5 and 11.

The following parabolic elements are those calculated by the last two observers mentioned above, and they are based on Schaumasse's observations at Nice on May 6, 7, and 8:—

T = 1913 May 15·4222 M.T. Paris.
ω = 53° 32′ 8″
☊ = 315 21 7 } 1913·0
i = 152 31 26
log q = 0·162920

Ephemeris for 12h. M.T. Paris.

	α (h. m. s.)	δ
May 30 ...	17 45 55 ...	+38 31
June 1 ...	17 15 56 ...	+40 6
,, 3 ...	16 45 33 ...	+41 9
,, 5 ...	16 15 50 ...	+41 35

EFFECTIVE TEMPERATURES OF STARS.—An important communication is published in the *Comptes rendus* of May 5 (vol. clvi., No. 18, p. 1355), by Dr. Charles Nordmann, relative to the effective temperatures of stars. It will be remembered that Dr. Rosenberg published recently (*Astronomische Nachrichten*, No. 4628, p. 360) the results of measures of the effective temperatures of seventy stars based on the determinations of the intensity of the photographic spectra. It will be remembered also that Dr. Nordmann made a like series of measures based, on the other hand, on visual observations. As the two series of measures deal with different regions of the spectrum they may be considered as independent determinations, and Dr. Nordmann here compares the results obtained in cases where the same star has been measured. The following table shows the resulting comparison:—

	Effective temperatures (in absolute degrees)		
	Nordmann λλ 460–630	Rosenberg λλ 400–500	Spectral types (Lockyer)
δ Persei	18500 ...	15500 ...	Algolian
...	15200 ...	23000 ...	Crucian
β ,, (Algol)	13300 ...	12000 ...	Algolian
α Lyræ (Vega)	12200 ...	22000 ...	Sirian
α Persei	8300 ...	6500 ...	Polarian
α Ursæ Minoris (Polaris) ...	8200 ...	5200	,,
α Canis Minoris (Procyon) ...	6800 ...	7000 ...	Procyonian
γ Cygni	5620 ...	5100 ...	Polarian
Sun	5320 ...	4950 ...	Arcturian
α Aurigæ (Capella)	4720 ...	4500 ...	,,
β Andromedæ	3700 ..	2650 ...	Antarian
α Tauri (Aldebaran)... ...	3500 ..	2150 ...	Aldebarian

Dr. Nordmann directs attention to the good agreement of the two series, with one or two exceptions, which he discusses, and points out that if the stars be arranged in the order of ascending temperatures they become hotter and hotter as one passes from the

Aldebarian and Antarian types to helium stars. This, he states, conforms to the thermal classification which Sir Norman Lockyer deduced from his qualitative study of the stellar spectra.

THE WORK OF SIR WILLIAM HUGGINS.—Under this heading, in *The Astrophyical Journal* for April (vol. xxxvii., No. 3) Prof. G. E. Hale takes the opportunity of again cheering up those astronomical observers who possess only a small and limited instrumental equipment, and may conceive the idea that the multiplication of large instruments renders any attempt at research on their part useless. Being the director of an observatory which may be considered the best equipped, contains the largest instruments, and is situated on a nearly ideal mountain site, it may appear that he is only trying to console workers with modest means. But this is not so. Prof. Hale knows the value of both large and small instruments, and there is abundant work for both classes. The reader should look through this article and he will find depicted there the magnificent work of amateurs, in spite of the fact that large instruments were in active employment at the time the work was done. Sir William Huggins he takes as an example of one of "that great English group of amateurs," and he directs attention to the fact that while in 1856 he acquired his first telescope, a 5-in. refractor, in 1858 an 8-in., and in 1870 an 18-in. reflector, such powerful instruments as 15-in. refractors at Pulkowa and Harvard, Lord Rosse's 6-ft. reflector, Lassell's 4-ft. reflector, the Melbourne 4-ft. reflector, &c., did not deter him from securing results of the highest importance.

Prof. Hale concludes in the following terms:—"Every investigator may find useful and inspiring suggestions in the life and example of Sir William Huggins. Their surest message and strongest appeal will be to the amateur with limited instrumental means, and to the man, however situated, who would break new ground."

THE SCOTT EXPEDITION TO THE ANTARCTIC.

THE huge audience which filled the Albert Hall on Wednesday evening, May 21, on the occasion of the Royal Geographical Society's meeting to hear Commander Evans's account of the Scott expedition to the Antarctic, showed no less by its eager plaudits than by its suppression of them at the fitting moments that the public sense of the tragedy of the expedition is not dulled by familiarity. Yet throughout the proceedings there was no false note of sentiment; the president, Lord Curzon, stated, without risk of misunderstanding, that the tribute of the society to the dead had been paid already, and begged any (and there were some) who felt that "this great reception is inconsistent with the feelings of sorrow which affect us all" to "abandon such a reflection," for that he was sure that Scott himself would not have had his companions forgo the reward of their labour. And the story of the expedition was told by Commander Evans very simply; he exhibited the sense of loss which all his collaborators share in a few words only, and by implication rather than by direct statement. Finally, the tribute paid by both president and lecturer to the generosity of the public and to the Government for the provisions made for the dependants of those who are lost showed that any criticism which has been directed against the allowances made from the public funds is without official concurrence.

It was satisfactory to learn that the funds subscribed will admit of the proper publication of the scientific results of the expedition. As regards these results, not a great deal emerged from the lecture which was not already realised by those who have taken interest in this aspect of the work accomplished. Nor was it to be expected that any detail should be given within the compass of a single lecture, though long; for it was long, and a tribute is due to Commander Evans, who so ably sustained the strain of delivering it, and never for a moment allowed the intense interest of the audience to wane. And here a word, though perhaps scarcely appropriate in this place, may be permitted in commendation of the singularly well-chosen organ music which was given before the opening of the proceedings.

But if it is scarcely possible, after hearing the lecture, to add materially to what is already known as to the scientific results of the expedition, it is right at the outset to record the full measure in which the value of those results has clearly been enhanced by photography. Obviously no photographer to any expedition has laboured with a more thorough sense of his duty, or more successfully, than Mr. Ponting. The lecture was delivered with lowered lights and with an accompaniment of lantern slides throughout, and was followed by a few kinematograph films of extraordinary interest. It is impossible to over-praise the beauty of the photographs, nor is it easy to select those of chief scientific interest, though an exquisite series showing new ice at successive stages of formation may be specially mentioned. Of the moving pictures, those of the killer whales were singularly clear, though the motion of creatures of their kind is familiar to many; those which showed seals leaving and entering the water through ice-holes were of even greater interest and value.

Some wonder has been expressed, with the vast area unexplored in the Antarctic region and the many problems awaiting solution in mind, that Scott elected to follow Shackleton's route, or even (and this criticism dates from early Arctic days) that he or anyone else should desire to reach the geographical pole at all. Against this there should be recalled the desire once expressed by a high Antarctic authority, that the south pole should be reached as quickly as possible since, until it should be, explorers would not rest content with work in other directions merely. On this count criticism is scarcely to be directed against Scott's expedition, for it included the largest scientific staff ever taken to the Antarctic, and scientific research certainly played no subordinate part in relation to the journey to the pole. We know already of the devotion with which Scott himself and his lost companions carried their geological specimens to the end of those last dreadful marches. Commander Evans showed how the three weeks during which the ship was held in the pack on the outward voyage were "not wasted," for magnetic observations, soundings, and serial sea temperatures were obtained, while marine biological work of importance was also done. Only the impossibility of finding a suitable base at Cape Crozier prevented the expedition from landing there in order that the embryology of the emperor penguins during winter might be studied. Wilson afterwards made his famous winter expedition thither, and one heard how he recorded the unimaginable temperature of 109° of frost.

Mr. Griffith-Taylor's party, which traversed the Ferrar Glacier, broke new ground, reaching a valley free of snow, containing a fresh-water lake only surface-frozen and full of algæ. Gravels in this limestone region, rich in garnets, "were washed for gold, but only magnetite was found." Commander Evans also paid tribute to Dr. Simpson's work as physicist and meteorologist, which was carried on after his departure by Mr. Wright, who also "made a special

study of ice structure and glaciation." Lieut. Campbell's party, in spite of extraordinary hardships, which included wintering away from its base, for which it was not prepared, was very successful in meteorological, magnetic, geological, and surveying work, while the penguins were the object of further study. Commander Evans had time to commend the work of Mr. Griffith-Taylor on the coast of Victoria Land (in geology and surveying), as well as that carried out on the ship, not only in the open ocean, but on the less-known coasts of New Zealand, no more fully than to intimate that each of these departments of the whole great undertaking is worthy of a lecture to itself, which it is to be hoped may be devoted to it.

Finally, reference is due to the results of the determination of the position of the south pole itself, as obtained by Amundsen and by Scott. The latter fixed the exact spot by means of a 4-in. theodolite, "at a point which only differed from Amundsen's reckoning by half a mile," that is to say, "by one scale division on the theodolite, which was graduated to half a minute of arc. Experts in navigation and surveying will always look on this splendidly accurate determination as a fine piece of work, by our own people as well as by the Norwegian explorers."

At the annual meeting of the society on Monday last, in the Theatre, Burlington Gardens, Lady Scott was presented by Earl Curzon with the patron's medal and the special Antarctic medal awarded to her husband in 1904, inclosed in an inscribed silver casket. Mrs. Wilson also received a patron's medal awarded to Dr. E. A. Wilson. To Lieut. Campbell was presented a gold watch as a special award.

THE BRITISH SCIENCE GUILD.

THE seventh annual meeting of the British Science Guild was held at the Mansion House on May 21, the Lord Mayor in the chair. In his opening remarks, the Lord Mayor made sympathetic reference to the aims and work of the guild, which, he said, seeks to further the application of scientific methods to all human endeavour and advocates the adoption of measures for the conservation of natural resources; in other words, its desire is to foster national efficiency. The Right Hon. Sir William Mather was elected president of the guild in succession to Lord Haldane, who has been president since its foundation. The new vice-presidents elected were Lord Sydenham, the Right Hon. the Lord Mayor of London, the Right Hon. Sir John Brunner, Bart., Sir Patrick Manson, and Sir Philip Watts; and other new members added to the executive committee are Mr. Charles Bathurst, M.P., Mr. R. Kaye Gray, Sir Philip Magnus, M.P., and Mr. Robert Mond.

The annual report, which was adopted at the meeting, surveys the activities of the guild in many directions. Reference is made in it to the new Post Office service for the synchronising of clocks—a subject which the guild has done much to promote. Other matters referred to are the final report of the Royal Commission on Tuberculosis, the new horticultural branch of the Board of Agriculture and Fisheries, the conversion of the Sleeping Sickness Bureau into the Tropical Diseases Bureau, the Society for the Promotion of Nature Reserves, and the Royal Commissions and Departmental Committees appointed during the year to deal with subjects with which science has some relationship. All these Commissions and Committees have been announced already in NATURE, but the report of the guild brings them together in a convenient form as a record of official action.

The various committees of the guild continue to do valuable work. The medical and agricultural committees have drawn up a report on the Government's Milk and Dairies Bill. While recognising that the Bill is a very decided advance in the direction of obtaining pure milk, the committees feel that in certain respects stronger and more drastic action should be taken. A note upon the report of the committees appeared in NATURE of May 1 (p. 222).

A report on tide and wave energy, and on the possibility of utilising this form of energy for power purposes, is being drawn up by the committee on the conservation of natural sources of energy; also a report on the utilisation of peat, which occurs in such enormous quantities in some districts in the British Isles and British possessions.

Owing to the declaration of the Government of the intention to bring in a comprehensive scheme to reorganise the educational system of the country, a joint committee of the education committee and the technical education committee, with Sir William Mather as chairman, was appointed to consider the subject. A valuable report has been drafted, which urges that a scientific system of national education demands:—

(1) The duty of local authorities to make such provisions as will promote healthy growth during infancy and throughout school life.

(2) The absolute necessity of manual work and related practical exercises throughout the whole course of school instruction, and also in the training of teachers.

(3) Efficient public elementary schools within the reach of all children, and attendance at school compulsory until the age of fourteen years is reached.

(4) Attendance at continuation schools for at least six hours per week obligatory up to seventeen years of age for all young persons not otherwise receiving suitable education.

(5) Suitable secondary schools available for all who can profit by them and will undertake to complete the full course of instruction.

(6) The institution of school certificates to serve as passports to higher schools or universities, or as testamurs of satisfactory completion of a school course.

(7) Examinations to occupy a secondary place in comparison with school records for the award of certificates, or to qualify for promotion to higher courses of study.

(8) Coordination of technical institutions and faculties of technology in universities in order to prevent overlapping and render specialised types of technological training available to students who have the capacity to profit by them.

(9) Increased grants to universities and other places of higher education for the purposes of ensuring the reduction of fees for all courses and promoting post-graduate research.

(10) The position and condition of service of teachers of every grade to be greatly improved in order to encourage men and women of the highest aptitude and qualifications to devote their lives to the work of teaching and the advancement of knowledge.

(11) Readjustment of the shares of the cost of education borne by the National Exchequer and by local authorities, so that educational progress may be made primarily a national responsibility.

The synchronisation of clocks committee refers to the Government action in connection with the subject, already mentioned. Since the guild took the matter up the Post Office has always viewed the matter sympathetically, and this new departure will, if it be taken up by those exposing public clocks, be

of the utmost value. It is hoped that the railway companies, at least in the metropolis, will take advantage of this enterprise on the part of the Postmaster-General. The borough councils have in the past not been very sympathetic, but perhaps, now that the matter will be arranged for them by the Post Office at such a trifling cost, they will adopt a more progressive attitude.

The explosives committee has considered the question of the available sources of nitrates, and the possibility of obtaining them during war; also the feasibility of manufacturing nitrates on a large commercial scale in this country. The committee considers that it is of the utmost importance that nitrates should be manufactured in Great Britain, even if the manufacture is not profitable; it is, however, of opinion that a commercially successful scheme is possible.

In the report of the Canadian committee reference is made to the conservation of natural resources of Canada. A source of great loss to the country is the prevalence of forest fires, and last year the Government spent the sum of 312,500*l.* in protection against this source of loss. The protection of native birds is also referred to. Much useful work has recently been done by the Canadian Waterways Commission, and in connection with this Dr. H. T. Barnes, the hon. secretary of the Canadian committee of the guild, has continued his valuable researches on ice formation in the St. Lawrence. Other subjects dealt with are radium standards, university settlement, prevention of tuberculosis, and free ice for the poor.

Appended to the report are the reports of committees dealing with the Milk and Dairies Bill, the work of the Canadian branch, and on a national system of education. Prof. R. A. Gregory contributes an appendix in which benefactions exceeding 10,000*l.* for the purposes of science and higher education are recorded, and a comparison is made between the incomes of universities and colleges in the United States and that of State-aided universities in Great Britain. From this article it appears that the total receipts of universities in the United States in the year 1910–11 amounted to nearly nineteen million pounds, and the benefactions to four and a half millions. In the same year, the total receipts of those universities and university colleges in Great Britain which participate in the Treasury grant were little more than 600,000*l.* The receipts from fees in England amounted to rather less than 32 per cent. of the total income. The amount received from endowment was about 15 per cent.; the receipts from local authorities 15·6 per cent. The total receipts of all kinds from the Exchequer amounted to 28·5 per cent. of the income.

As regards numbers of students in universities and technological institutions of university standard, comparison is made with Germany. There are twenty-one universities in the German Empire and eleven technical high schools or technical universities having the power to grant degrees. Taking the universities and technical high schools together, the statistics show that in the year 1910–11 they had about 71,000 matriculated students. The total number of full-time day students in the universities and university colleges of England and Wales (including those of Oxford and Cambridge) in 1910–11 was about 17,000, and in Scotland about 7600, in comparison with 55,000 in German universities. In the technical institutions of the United Kingdom, the number of day students in attendance was about 2000, in comparison with 16,000 in the technical high schools of Germany. From other tables given in the article it appears that more than 90 per cent. of the pupils in the State-aided secondary schools of England and Wales are under sixteen years of age, and one-quarter of the pupils are under twelve years of age. More than four-fifths of the pupils have not passed an examination of university matriculation standard when they leave school. Two per cent. of the pupils proceed to universities, and 7 per cent. to technical schools and institutions, medical schools, training colleges for secondary-school teachers, and like places providing special training for professions, trades, or commercial occupations.

RECENT WORK IN ECONOMIC ENTOMOLOGY.

VALUABLE memoirs published by the Entomological Division of the United States Department of Agriculture are constantly reaching us. Of these, Bulletin 110, on "The Spring Grain-Aphis, or Greenbug," by F. M. Webster and W. J. Phillips, is of more than passing interest. The species described—*Toxoptera graminum*, Rondani—has been noticed as seriously destructive to wheat and other cereals in North America—especially in the Middle Western States—during several seasons from 1890. In the eastern hemisphere it has been recorded only from a few localities—Italy, Hungary, Belgium, India, South and East Africa. The bulletin, extended to 150 pages, gives a full account of the insect, its embryology, post-natal development, habits, and natural enemies. An interesting bionomical observation is that south of the 35th parallel the species reproduces itself only by successive generations of virgin females, and even further to the north the sexual generation may be omitted from the life-cycle in mild winters.

Another bulletin which contains welcome original contributions to our knowledge of the life-history of Hemiptera is No. 108, on "Leafhoppers affecting Cereals, Grasses, and Forage Crops," by Prof. Herbert Osborn. H. M. Russell's contribution (No. 118) on the bean thrips (*Heliothrips fasciatus*) is also noteworthy. It is needless to add that these bulletins all deal with practical means for the extermination or control of the pests.

As a contribution to animal parasitology, Bulletin 106, "The Life-history and Bionomics of some North American Ticks," by W. A. Hooker, F. C. Bishopp, and H. P. Wood, is worthy of mention. It forms an excellent introduction to the ticks of pathological importance, giving diagnostic characters of genera and species, and furnishing in each case details of the early stages in the life-history.

From the Canadian Department of Agriculture we have received Dr. C. Gordon Hewitt's Bulletin, No. 10, on the large larch sawfly (*Nematus Erichsonii*). This paper gives, in a handy form, particulars of the prevalence of the insect as a larch-destroyer in Europe and North America. British entomologists are familiar with Dr. Hewitt's work in connection with this insect in the Cumbrian lake district. He finds it still more injurious across the Atlantic, where, he believes, it must be regarded as an introduced species. Naturally he is endeavouring to acclimatise in Canada the ichneumon-fly (*Mesoleius tenthredinis*), which reduced so considerably the sawfly population on the shores of Thirlmere.

Dr. Hewitt has found time also to contribute to *Parasitology* (vol. v., No. 3, 1912), a short account of the larvæ and bionomics of *Fannia canicularis* and *F. scalaris* (better known to most naturalists under the generic name of Homalomyia). These curious spinose maggots have an unpleasant interest as occasional inhabitants of the human intestinal and urinary tracts.

From the Imperial Indian Government's Agricultural Research Station at Pusa has been issued Bulletin No. 28 on "The Cultivation of Lac in the Plains of India," by C. S. Misra, a well-illustrated account of the insect (*Tachardia lacca*), the trees on which it thrives, their culture, the collection of the product, the manufacture of shellac, and its economic uses. The most dangerous enemies of the lac insect appear to be the predaceous caterpillars of four species of moth.

FORESTS AND CLIMATE.

THE very general belief in the influence of forests upon climate, and especially upon rainfall, is discussed by Prof. R. de Courcy Ward in an interesting article in the April number of *The Popular Science Monthly*. The subject is very complicated, and the author points out that we must be careful not to put the cart before the horse; in other words, the forests are the result of the rainfall, and not *vice versâ*.

The various questions involved are discussed in detail, the following being among the points dealt with:—(1) The historical method; (2) why forests should influence climate; (3) influence upon (*a*) temperature, (*b*) humidity and evaporation; (4) the cases frequently cited as showing an influence upon rainfall; (5) recent European studies. Among the authorities quoted, Hellmann has shown that the increase in the rainfall over a forest is accompanied by a lessened fall to leeward—simply a slight difference in distribution. Both Voeikof (Russia) and Hann (the leading authority on climate) believe that the vast tropical forests may increase the amount of rainfall. But as regards our own latitudes the author considers that there is at present no conclusive evidence that forests have a significant effect upon the amount of rain*fall*, as distinguished from the amount of the rain*catch* in the gauge.

There is comparatively little popular interest in the possible influence of forests upon temperature; the forest is a little cooler than the open in summer, and possibly very slightly warmer in winter. Supan sums up the case as follows:—"No one will care to maintain that the system of isotherms would be radically altered if Europe and Asia were one great forest from ocean to ocean." With regard to moisture, the author thinks that the local supply from forests cannot play any considerable part in the great rain-producing processes.

SYSTEMS OF LONG-DISTANCE WIRELESS TELEGRAPHY.

THE Advisory Committee appointed by the Postmaster-General to consider and report on the merits of existing systems of long-distance wireless telegraphy has made its report. The Committee heard evidence in private from representatives of the Marconi, the Telefunken, the Poulsen, the Goldschmidt, and the Galetti interests, and of the Admiralty, and the members visited a number of stations.

The report is strictly limited to practical considerations, and deals with matters of engineering rather than of scientific interest. From the point of view of the building of stations for immediate operation in the Imperial wireless chain, the report is overwhelmingly in favour of the Marconi Company, not only on account of its plant, but also on account of its experience; though the Committee points out that it would be possible for the Government to get together a highly trained staff and erect the stations, using any desirable patents under the provisions of section 29 of the Patents and Designs Act, 1907. The Marconi spark plant was tested by the Committee as to duplex working, and as to automatic transmission at the rate of sixty words per minute, across the Atlantic, a distance of 2300 miles. The Committee found Transatlantic communication practically continuous, though there are periods when the signals become very weak; and there are occasional periods when no signals at all can get through. These weak periods are due to natural causes, and can probably only be overcome by the use of high powers.

The Committee received no evidence supporting the reported transmission from San Francisco to Honolulu (2100 miles) by the Poulsen arc, but witnessed transmission over a relatively short distance at seventy words per minute. The members also saw the Goldschmidt alternator transmit at the rate of sixty words per minute. It is interesting to note that the Marconi Company and the Telefunken Company are both experimenting with generators of continuous waves. The Marconi machine consists essentially of a rapidly rotating contact-maker in a direct-current circuit with special dispositions of other circuits to give continuous oscillations in the antenna. The Telefunken machine is an alternator constructed to give as high a fundamental frequency as may be convenient in the first instance, the frequency being doubled or quadrupled by a polarised transformer method. The Marconi machine was witnessed working across the Atlantic.

SOME FURTHER APPLICATIONS OF THE METHOD OF POSITIVE RAYS.[1]

THE method to which I shall refer this evening is the one I described in a lecture I gave here two years ago. The nature of the method may be understood from the diagram given in Fig. 1. A is a vessel containing the gases at a very low pressure; an electric discharge is sent through these gases, passing from the anode to the kathode C. The positively electrified particles move with great velocity towards the kathode; some of them pass through a small hole in the centre, and emerge on the other side as a fine pencil of positively electrified particles.

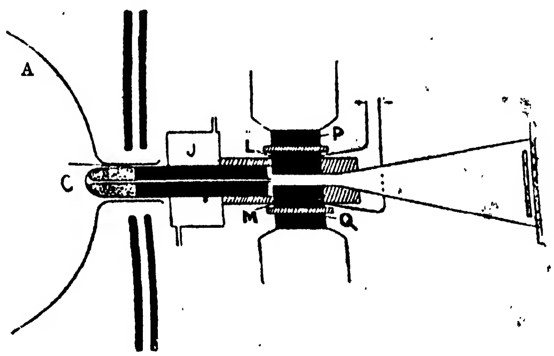


FIG. 1.

This pencil is acted on by electric forces when it passes between the plates L and M, which are connected with the terminals of a battery of storage cells, and by a magnetic force when it passes between P and Q, which are the poles of an electromagnet. In the pencil before it passed under the influence of these forces there might be many kinds of atoms or molecules, some heavy, others light, some moving quickly, others comparatively slowly, but these would all be mixed up together. When they are acted on by the electric and magnetic forces, however, they get sorted out, and instead of travelling along the

[1] Discourse delivered at the Royal Institution on Friday, January 17, by Sir J. J. Thomson, O.M., F.R.S.

same path they branch off into different directions. No two particles will travel along the same path unless they have the same mass as well as the same velocity; so that if we know the path of the particle we can determine both its mass and its velocity. In chemical analyses we are concerned more with the mass than with the velocity, and we naturally ask what is the connection between the paths of particles which have the same mass but move with different velocities. The answer is that all such paths lie on the surface of a cone, and that each kind of particle has its own cone; there is one cone for hydrogen, another for oxygen, and so on. Thus one cone is sacred to hydrogen, and if it exists there must be hydrogen in the vessel; so that if we can detect the different cones produced from the original pencil, we know at once the gases that are in the tube. Now, there are several ways of identifying these cones, but I shall only refer to the one I have used in the experiments I wish to bring before you this evening. These moving electrified particles, when they strike against a photographic plate, make an impression on the plate, and a record of the place where they struck the plate can be obtained. Thus, when a plate is placed in the way of the particles streaming along these cones, the sections of these cones by the plate (parabolas) are recorded on the photograph, hence we can identify these cones by the parabolic curves recorded on the photograph, and these parabolas will tell us what gases are in the vessel.

The first application of the method which I shall bring before you this evening is to detect the rare gases in the atmosphere. Sir James Dewar kindly supplied me with two samples of gases obtained from the residues of liquid air; the samples had been treated so that one might be expected to contain the heavier gases, the other the lighter ones. I will take the heavier gases first. The photograph of these is shown in Fig. 2. When the plate is measured up it shows a faint line corresponding to the atomic weight 128 (xenon), a very strong line corresponding to the atomic weight 82 (krypton), a strong argon line 40 (argon), and the neon line 20. There are no lines unaccounted for, and hence we may conclude that in the atmosphere there are no unknown gases of large atomic weight occurring in quantities comparable with those of xenon or krypton. This result gives an example of the convenience of the method, for a single photograph of the positive rays reveals at a glance the gases in the tube. I now turn to the photograph of the lighter constituents shown in Fig. 3; here we find the lines of helium, of neon (very strong), of argon, and, in addition, there is a line corresponding to an atomic weight 22, which cannot be identified with the line due to any known gas. I thought at first that this line, since its atomic weight is one-half that of CO_2, must be due to a carbonic acid molecule with a double charge of electricity, and on some of the plates a faint line at 44 could be detected. On passing the gas slowly through tubes immersed in liquid air the line at 44 completely disappeared, while the brightness of the one at 22 was not affected.

The origin of this line presents many points of interest; there are no known gaseous compounds of any of the recognised elements which have this molecular weight. Again, if we accept Mendeléef's periodic law, there is no room for a new element

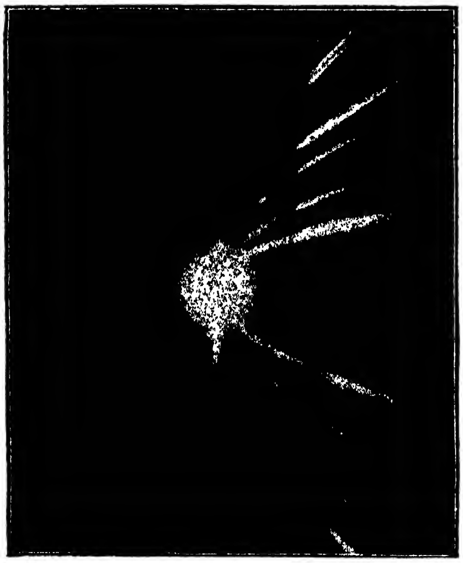


Fig. 2.

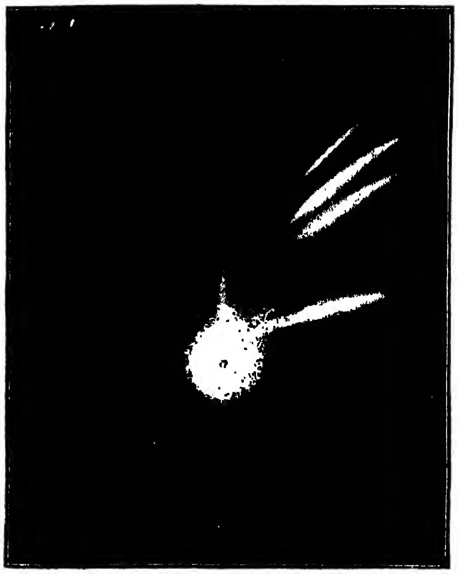


Fig. 3.

with this atomic weight. The fact that this line is bright in the sample when the neon line is extraordinarily bright, and invisible in the other when the neon is comparatively feeble, suggests that it may possibly be a compound of neon and hydrogen, NeH_2, though no direct evidence of the combination of these inert gases has hitherto been found. I have two photographs of the discharge through helium in which there is a strong line, 6, which could be explained by the compound HeH_2, but, as I have never again been able to get these lines, I do not wish to lay much stress on this point. There is, however, the possibility that we may be interpreting Mendeléef's law too rigidly, and that in the neighbourhood of the atomic weight of neon there may be a group of two or more elements with similar properties, just as in another part of the table we have the group iron, nickel, and cobalt. From the relative intensities of the 22 line and the neon line we may conclude that the quantity of the gas giving the 22 line is only a small fraction of the quantity of neon.

Let me direct your attention again to the photo-

graph of the heavier gases in the atmosphere. You will notice that the parabolas corresponding to many of the elements start from points which are all in the same vertical line; this indicates that the atoms or molecules which form these parabolas all carry the same charge. Several of these lines, however, do not follow this rule; you will notice, for example, that the neon line has a prolongation which comes nearer than the normal line to the vertical line drawn through the undeflected spot. Measurement of the photograph shows that the neon line begins at a distance from this vertical line which is only half the normal distance; this shows that some of the neon atoms in the positive rings possess two charges of electricity; the majority of them, however, only possess one. If you examine the argon line you will find that it comes even nearer to the vertical than the neon line; in fact, it begins at a distance from the vertical only one-third of the normal distance; this proves that the argon atom can have as many as three charges of electricity. If now you examine the krypton line you will find that it comes nearer to the vertical line than even the argon; its least distance is one-fourth of the normal distance, showing that the krypton atom may have as many as four charges. The mercury line comes so close to the vertical line that it is only on large photographs that it can be seen that there is in reality an interval; this interval is only one-eighth of the normal interval, showing that mercury may acquire eight positive charges, *i.e.* that it may lose eight corpuscles. The mercury atom when it is on this line must have only the normal charge, *i.e.* it must have regained all but one of the corpuscles it previously lost; if it had retained two positive charges it would have been on the line corresponding to the atomic weight 200/2 or 100; if it had retained 3, or 4, 5, 6, 7, 8 on the lines corresponding to the atomic weights, 200/3, 200/4, 200/5, 200/6, 200/7, 200/8 respectively. All these except the last have been detected on the plate. The lines corresponding to the multiple charges on krypton, argon, and neon have also been detected. It appears, then, that in a vacuum tube a mercury atom, for example, may be ionised in two ways; in the one way the atom loses one corpuscle, in the other it loses eight.

I would suggest that these two types of ionisation may result from the two different types of collision which the atom must experience. The first type is collision with a corpuscle; since the corpuscle is an exceedingly small body moving with a very great velocity, it can pass freely through the atom, and the collision it makes with the atom is really a collision with a corpuscle inside the atom; this may result in the corpuscle it strikes acquiring such a great velocity that it is able to escape from the atom; this type of collision will result in the detachment of a single corpuscle. The second type of collision is when the atom collides with another atom and not with another corpuscle; the result of this collision may be that the atom suffers a sudden change in its velocity. This change is not at first shared by the corpuscles, so that these just after the collision may have a very considerable velocity relative to the atom. If there are several corpuscles which are comparatively loosely attached to the atom, these may all be detached from it and leave it with a positive charge corresponding to the number shaken out. It is this type of collision which we regard as giving the multiply-charged ions, and we see that the magnitude of the charge is a measure of the number of corpuscles in an atom which are readily detachable from it. We have seen that the greater the atomic weight the greater the charge it can acquire, the maximum charge being roughly proportioned to the square root of the atomic weight, hence the heavy elements have a larger number of detachable corpuscles than the lighter ones.

Another application of the method I should like to bring before you is the use of it for the discovery and investigation of a new substance. I have in previous lectures said that sometimes there appeared on the plates a line corresponding to a particle with an atomic weight 3; this must either be a new element or a polymeric modification of hydrogen, represented by H_3. The other possibility that it is a carbon atom with four charges is put out of court by the fact that it frequently occurs when the carbon line is exceedingly faint, and when there is not a trace of a carbon atom with even two charges, though the doubly-charged carbon atom occurs readily under certain conditions. In addition to this, the carbon atom parabola never approaches the vertical near enough to allow of its having four charges. I thought the study of the substance producing this line would be of interest, and I have for some time been working at it, and although the research is by no means completed, I have obtained some results which I should like to bring before you.

At first I was greatly hindered by not knowing the conditions under which the line occurred; although it appeared from time to time on the plates, its appearance was always fortuitous and sometimes for weeks together the plates would not show a trace of the line. The line sometimes appeared, but why it did so was a mystery, and I could not get it when I wanted it. I began an investigation, which proved long and tedious, to find the conditions under which the line appeared. I tried filling the discharge-vessel with all the gases and vapours described in the books on chemistry without success. At last I tried bombarding various substances with kathode rays. Under this treatment the substances give off considerable quantities of gas the greater part of which is hydrogen, carbonic acid, or carbon monoxide. When I came to analyse by the positive rays the gases given off in this way, I found that with a large number of substances these gases contained the substances giving the three lines, so that I was now in a position to get this line whenever I wanted it, and investigate the properties of the gas to which it owes its origin. The question of the gases absorbed and given off by solids is an extremely interesting one, and a considerable number of investigations have been made on it. In all these, so far as I know, the method has been to heat the solid to a high temperature, and then measure and analyse the very considerable amount of gas which is driven off by the heating. So far as I know, no experiments have been made in which the gases were driven off by bombardment with kathode rays. This treatment, however, will cause the emission of gas even when ordinary heating fails to do so.

Belloc, who has recently published[2] some interesting experiments on this subject, after spending about six months in a fruitless attempt to get a piece of iron in a state in which it would no longer give off gas when heated, came to the conclusion that, for practical purposes, a piece of iron must be regarded as an inexhaustible reservoir of gas. There are some interesting features about the emission of gas from a heated solid. If the body is kept for a long time in a vacuum at a high temperature, the emission of gas becomes too small to be detected; if after this treatment the temperature is raised considerably, there will be a further copious emission of gas, which again diminishes as the heating continues. After it has fallen to zero, all that is necessary is to raise the temperature again and you will get a fresh supply of gas; and so far as my experience goes, after you

[2] *Ann. de Chimie et de Physique* [8], xviii., p. 569.

have got all the gas you can out of the solid by heating it, you have only to expose it to kathode rays to get a fresh outburst. This effect of increased temperature in renewing the stream of gas from the solid seems to me to be too large to be accounted for merely by an increase in the rate of diffusion of the absorbed gas from the interior to the surface; it seems to be more analogous to the case of the emission of the water of crystallisation from some salts. There are some salts, for example, copper sulphate, which when heated lose their water of crystallisation in stages; thus, if the temperature is raised to a certain value, some of the water of crystallisation comes off, but the rest remains fixed, and you may keep the salt at this temperature for ever without getting rid of all the water of crystallisation; on raising the temperature, however, fresh water of crystallisation is given off. Something of this kind seems to take place in the case of gases absorbed in metals, and there seem to be indications that there is some kind of chemical combination between the gas and the metal. This absorbed gas may influence the behaviour of the substance. For example, an ordinary carbon filament gives off, when raised to a white heat, large quantities of negatively electrified corpuscles; but Pring and Parker[3] have shown that when great precautions are taken to get rid of the absorbed gas, the emission of these corpuscles falls to less than one-millionth of their previous value. It is in the gases given off by certain metals when they are bombarded by kathode rays that I have found an unfailing source of the substance, which I shall denote by X_3, giving the line corresponding to the atomic weight 3. The arrangement I have used for investigating the presence of this gas is shown in Fig. 4. A is a vessel communicating with the bulb B in which the positive rays are produced by two tubes, one of which is a very fine capillary tube, while the other one is five or six millimetres in diameter; taps are inserted so that one or both of these vessels can be closed, and the vessels A and B isolated from each other. A is provided with a curved kathode such as are used for Röntgen ray focus tubes, and the kathode rays focus on the platform on which the substance to be bombarded is placed. (It is not absolutely necessary to focus the kathode rays in this way, but it makes the supply of the gas X_3 more copious.) After the metal or other solid to be examined has been placed on the platform, the taps between A and B being turned so as to cut off the connection between them, A is exhausted until the vacuum is low enough to give the kathode rays; the discharge is then sent through A, and the kathode rays bombard the solid. The result of this is that in a few seconds so much gas, mainly CO_2 and hydrogen, is driven out of it that the pressure gets too high for the kathode rays to be formed, and unless some precautions to lower the pressure were taken the bombardment would stop. To avoid this, a tube containing charcoal cooled by liquid air is connected with A, and this absorbs the CO_2 and enough of the hydrogen to keep the vacuum in the kathode ray state. To see what new gases are given off in consequence of the bombardment, a photograph is taken while the connection between A and B is cut off. After this is finished, and when the bombardment has gone on for about four hours, the tap is turned and a little of the gas from A is allowed to go into B; another photograph is taken, and those lines in the second photograph which are not in the first represent those gases which are liberated by the bombardment, and have escaped being absorbed by the charcoal. I have here a slide (Fig. 5) representing the result of bombarding nickel. There are two photographs, one

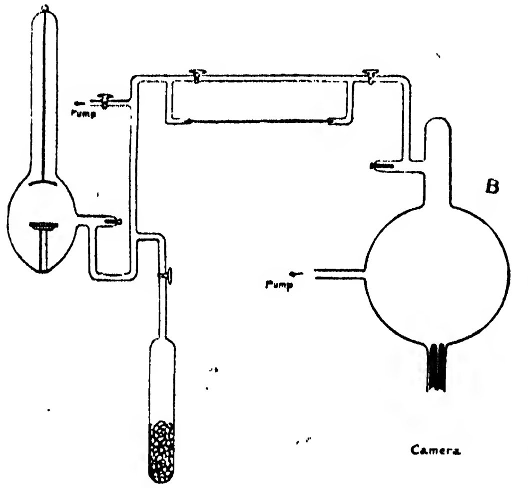
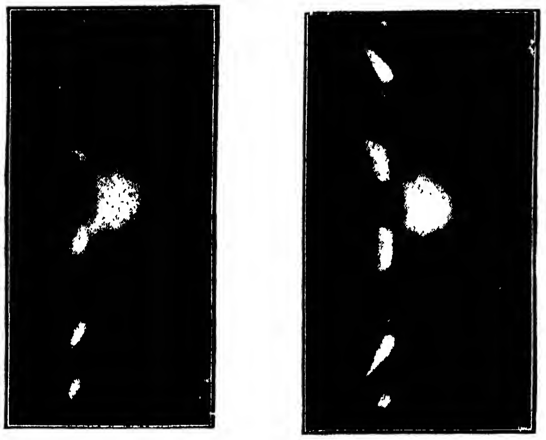


FIG. 4.



(α) before turning the tap, and the other (β) after; in the second you see the 3 line very distinctly, while it is absent from the first, showing that the gas giving the 3 line has been liberated by the bombardment. I have got similar results to these when, instead of nickel, iron, copper, lead, and zinc have been bombarded. I have tried two specimens of meteorites kindly lent to me from the Mineralogical Museum, Cambridge, and found there the 3 line. Nearly every substance I have tried gives, the first time it is bombarded, the helium line as well as this line due to X_3; if, however, the same substance is bombarded a second time, the helium line is in general absent (occasionally it is still to be detected, though exceedingly faint); and on the third bombardment is invisible in all the substances I have tried except monazite sand, where it is given off in exceedingly large quantities so long as the bombardment continues. It is remarkable that monazite sand, which contains so many elements, gives no trace of the 3 line when bombarded.

I have also obtained the X_3 line and also the helium line when the tube A was replaced by one containing a Wehnelt kathode; with this the current of kathode rays through the tube was much larger than with the other kathode, though the velocity of the rays was

[3] *Phil. Mag.*, xxiii., p. 192.

smaller. The Wehnelt kathode gives the line without placing pieces of metal in the tube, so that in this case nothing is bombarded by the kathode rays but the glass walls of the tube; the strip of metal forming the kathode is, however, bombarded by the positive rays.

The 3 line when present at all continues even though the bombardment is very prolonged. In some cases the bombardment has been prolonged for twenty hours, and at the end of that time the line seemed almost as bright as at the beginning; indeed, I could not feel certain that there was any difference. This might lead one to suspect that X_3 was manufactured from the lead or other metal by the bombardment rather than stored up in it, and this view might be regarded as receiving some support from the fact that very little of the X_3 is liberated by heating. The following experiment is an illustration of this. I took a piece of lead, and instead of bombarding it with kathode rays I placed it in a quartz tube connected with vessel A, and heated the tube to a bright red-heat for several hours. Large quantities of CO_2 and hydrogen were driven off by this process; this was absorbed by charcoal, and the residual gases, which had accumulated in A, were admitted into the vessel B; the X_3 line and helium line could just be detected, and that was all. I then gave the lead a second heating, raising this time the temperature until the quartz was on the point of softening. The lead was boiling vigorously; the heating was kept up for about three hours. In this time about three-quarters of the lead had boiled away. I then let the gases which had been given off at the second heating into the vessel B, and took another photograph; no trace of the line due to X_3 or helium could be detected. The fraction of the lead which had not been boiled away was now placed in A and bombarded by kathode rays. It now gave the 3 line quite distinctly; the helium line was visible, but faint. By the bombardment with the kathode rays the lead was only just melted, so that the average temperature was much less than when it was heated in the quartz tube. This rather suggests that the X_3 might be due to a kind of dissociation of the metal by the kathode rays, and not to a liberation of a store of that substance. Another experiment shows, however, that for lead, at any rate, this view is not tenable. I took some lead which had just been deposited from a solution of lead acetate by putting a piece of zinc into the solution, and forming the well-known lead-tree. When I bombarded this freshly precipitated lead, I could get no trace of the X_3 line; the helium line, too, was absent. I then tried another experiment. I took a piece of lead and divided it into two parts. The first of these I bombarded by the kathode rays: it gave the X_3 line quite distinctly. The other part I dissolved in boiling nitric acid, getting lead nitrate. The nitrate was heated and converted into oxide, and this was bombarded by the kathode rays: it did not give the X_3 line, showing that the X_3 is not produced by the bombardment, but is something stored up in the lead, which can be detached from it when the lead is dissolved. I have tried several samples of lead; the one which gave the X_3 line most distinctly was a piece of lead from the roof of Trinity College Chapel, several hundred years old. A sample of Kahlbaum's chemically pure lead, which must, I suppose, at no distant date have been subjected to severe ordeals by fire and water, showed the line quite distinctly, though not so well as the older lead. I have tried similar experiments with iron, and found that iron which gave the 3 line very distinctly ceased to do so after it had been dissolved in acid.

As the most obvious explanation of X_3 is that it is H_3, bearing the same relation to hydrogen that ozone does to oxygen, and produced in some way from the hydrogen dissolved in the metal, I tried if I could produce it by charging metals with large quantities of hydrogen, and then seeing if the hydrogen coming from the metal gave any traces of H_3. Thus, for example, I tested the hydrogen given off from hot palladium, but found no trace of X_3. I then charged nickel at a temperature of about 355° C. with hydrogen in the way recommended by Sabatier, but found no increase in the brightness of the X_3 over nickel that had not been deliberately exposed to hydrogen. I tried if the brightness of the line would be increased by adding hydrogen to the bulb A, in which the bombardment took place, but found no effect. I also tried adding oxygen to this bulb, thinking that if it was H_3 it would combine with the oxygen, and thus be eliminated, but no great diminution in the intensity was produced by this treatment. The gas seems quite stable, at least it can be kept for several days without suffering any diminution that can be detected; indeed, when once it has got into a bulb, there is considerable difficulty in getting the bulb free from it. It must be remembered, too, that by the method by which it is produced the gas is subjected all the time to electric discharges which would break it up unless it possesses very great stability. Thus if X_3 is a polymeric modification of hydrogen, it must possess the following properties:—

(1) It must be very stable.
(2) it must resist the action of oxygen.
(3) It must not be decomposed by long-continued exposure to the electric discharge.

These are properties which *a priori* we should scarcely have expected an allotropic modification of hydrogen to possess.

Mendeléef predicted the existence of an element with an atomic weight 3. According to him this element should be intensely electro-negative and possess the properties of fluorine to an exaggerated extent. The gas X_3 can, however, be kept in glass vessels, which we should not expect to be possible if it possessed more than fluorine's power of combining with glass. I prefer to defer expressing any opinion as to the actual nature of the gas until I have had the opportunity of making further experiments upon it. It is only about two months ago that I found how to get the gas with any certainty, and, as the method involves long bombardments, each experiment takes a considerable time. This has prevented me from making several experiments which suggest themselves, and which ought to be made before coming to a final decision. I thought, however, that the investigation, though incomplete, might not be unsuitable for a Friday evening discourse, as the gas, whatever its nature, is certainly one of considerable interest, and its detection illustrates the delicacy of this new method.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Sudbury-Hardyman prize offered for an original dissertation by a graduate member of Emmanuel College under the standing of M.A. has been increased to 40*l*., and divided between G. E. K. Braunholtz, formerly scholar and research student, and R. D. Vernon, research student. Mr. Braunholtz's dissertation was "The Nomina of Italy, peculiar to Gallia Transpadana," and Mr. Vernon's "The Geology and Palæontology of the Warwickshire Coalfield."

THE electors to the Michael Foster research studentship in physiology give notice that there will be an

election to the studentship in the year 1913. Candidates are required to send in their applications to the professor of physiology before the end of June, with a statement of the course of research which they propose to undertake.

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Any system of solids or non-volatile liquids susceptible of giving rise by a new grouping of atoms to a system containing volatile bodies ought to enter into reaction at a suitable temperature. Thus it has been shown that at a very high temperature aluminium will react with magnesia, the magnesium formed being gaseous. The reduction of barium oxide by silicon is another example.—G. **Arrivaut**: Study of the system manganese-silver. Manganese and silver are capable of forming the combination $MnAg_2$; experimental evidence on this is given dealing with the melting-point curves, microscopical structure, electromotive forces, and chemical behaviour of various alloys of the two metals. This conclusion is opposed to that previously arrived at by G. Hindrichs.—Marcel **Gompel** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by the alkaloids of the atropine group. Absorption data are given for atropine, apoatropine, and cocaine.—MM. **Taffanel** and **Le Floch**: The combustion of gaseous mixtures. An examination of the causes of the lag in the inflammation of combustible mixtures of methane. Moisture was found to be without effect in reducing this lag.—J. **Aloy** and Ch. **Rabaut**: Benzoyl cyanhydrins of ketones, amides, and the alcohol acids from which they are derived.—E. E. **Blaise**: The characterisation of the chloro-ketones. The use of the semicarbazones was found to be advantageous for the identification of the chloro-ketones.—Alfred **Guillemard**: Nature of the optimum osmotic pressure in biological processes.—Jean **Daniel**: The relations existing between the age of the dicotyledons and the number of successive layers of their secondary woods. Under certain conditions of growth the number of concentric layers of secondary wood cannot be distinguished, and the number of years of growth cannot be determined by this means.—C. J. **Pitard**: The vegetation of Chouïa, Morocco.—M. **Hirtz**: Intensive galvanotherapy with feeble current density.—Louis **Roule**: Contribution to the study of the biology of the salmon.—L. **Bordas**: A case of lateral budding in *Lumbricus herculeus*.—J. **Bounhiol**: The reproduction of the Algerian sardine.—Albert **Berthelot**: Researches on the intestinal flora. The pathogenic action of a microbial association of *Proteus vulgaris* and *Bacillus aminophilus*. A study of the symbiosis of these two organisms *in vitro* leads to the conclusion that the *B. aminophilus* prevented to some extent the growth of Proteus, but experiments *in vivo* with white rats at once showed that the opposite was the case. Proteus alone, even in large doses, is without apparent influence on rats, but in association with the bacillus above-mentioned, enteritis is rapidly produced.—G. **Béchamp**: Concerning *microzyma cretae*. Remarks on a recent communication by Raphaël Dubois.—J. **Lesage**: Epizootic myocarditis of the sheep.—C. **Gerber**: Comparison of the hydrolysing diastases of the latex of *Maclura aurantiaca* with those of *Ficus carica* and of *Broussonetia papyrifera*.—J. **Vallot**: The value and variation of the temperature of the lower portion of the glacier of Mont Blanc.

BOOKS RECEIVED.

Fortschritte der naturwissenschaftlichen Forschung. Edited by Prof. E. Abderhalden. Achter Band. Pp. 308. (Berlin and Vienna: Urban and Schwarzenberg.) 15 marks.

Behaviour Monographs. Vol. ii., No. 1, Serial No. 6. The Delayed Reaction in Animals and Children. By W. S. Hunter. Pp. 86. (Cambridge, Mass.: H. Holt and Co.)

Cape of Good Hope. Department of Mines. Sixteenth Annual Report of the Geological Commission. 1911. Pp. 136+v. (Cape Town: *Cape Times*, Ltd.)

A Naturalist in Cannibal Land. By A. S. Meek. Edited by F. Fox. Pp. xviii+238+plates. (London: T. Fisher Unwin.) 10*s*. 6*d*. net.

The Living Plant. By Prof. W. F. Ganong. Pp. xii+478+plates. (New York: H. Holt and Co.) 3.50 dollars net.

The Child: its Care, Diet, and Common Ills. By Dr. E. M. Sill. Pp. viii+207. (New York: H. Holt and Co.) 1 dollar net.

The Fringe of the East. By H. C. Lukach. Pp. xiii+273. (London: Macmillan and Co., Ltd.) 12*s*. net.

Trans-Himalaya. By Sven Hedin. Vol. iii. Pp. xv+426+plates+maps. (London: Macmillan and Co., Ltd.) 15*s*. net.

A Dictionary of Applied Chemistry. By Sir E. Thorpe, assisted by eminent contributors. Revised and enlarged edition in five vols. Vol. iv. Pp. viii+727. (London: Longmans and Co.) 45*s*. net.

Ueber kausale und konditionale Weltanschauung und deren Stellung zur Entwicklungsmechanik. By W. Roux. Pp. 66. (Leipzig: W. Engelmann.) 1.50 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Lief. 34. (Jena: G. Fischer.) 5 marks.

DIARY OF SOCIETIES.

THURSDAY, MAY 29.

ROYAL SOCIETY, at 4.30.—*Acineta tuberosa*; a Study on the Action of Surface Tension in Determining the Distribution of Salts in Living Matter: Prof. A. B. Macallum.—Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. IV. The Mzimba Strain: Surg.-General Sir David Bruce, Major D. Harvey, Major A. E. Hamerton, and Lady Bruce.—Notes on *Toxoplasma gondii*: Helen L. M. Pixell.—An Investigation by Pedigree Breeding into the Polymorphism of *Papilio polytes*, Linn.: J. C. F. Fryer.—The Action of Radium Rays upon the Cells of Jensen's Rat Sarcoma: Dr. S. Russ and Dr. Helen Chambers.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. II. Chemistry in Space: Prof. W. J. Pope.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Section.—Irrigation Works in India: Sir John Benton, K.C.I.E.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Action of Ozone on Some Textile Fibres: Dr. C. Dorée.—Some Defects in Silk Dyeing: Dr. L. L. Lloyd.

FRIDAY, MAY 30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting. At 8.30.—Practical Application of Telephone Transmission Calculations: A. J. Aldridge.

PHYSICAL SOCIETY, at 5.—The Origin of New Stars: Prof. A. W. Bickerton.—Electro-thermal Phenomena at the Contract of Two Conductors with a Theory of a Class of Radio-telegraph Detectors: Dr. W. H. Eccles.—The Evaluation of Certain Combinations of the Ber, Bei, and Allied Functions: S. Butterworth.—The Extraordinary Ray Resulting from the Internal Reflection of an Extraordinary Ray at the Surface of an Uniaxal Crystal: J. Walker.

SATURDAY, MAY 31.

ROYAL INSTITUTION, at 3.—Radioactivity. II. The Origin of the Beta and Gamma Rays and the Connection between them: Prof. E. Rutherford.

MONDAY, JUNE 2.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems: Prof. W. Bateson.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Precipitation in Aqueous and Colloidal Systems: W. P. Dreaper.—Some Experiments on the Theory of Electro Tanning: E. K. Rideal and U. R. Evans.—An Illustration of the Partial Pyrite Process: W. R. Schoeller.—The Estimation of Alcohol in Beer by Means of Malligand's Ebullioscope: J. C. Cain.—The Joint Action of Catalysing Agents. Dehydration of Ethyl Alcohol and Ethyl Ether: General W. Spatiew.

INSTITUTE OF ACTUARIES, at 5.

TUESDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—Recent Advances in the Production and Utilisation of Wheat in England: Prof. T. B. Wood.

ZOOLOGICAL SOCIETY, at 8.30.—Notes on Turacin and Turacin-bearers: Sir A. H. Church.—Observations on the Anatomy of the Shoe-bill (*Balaeniceps rex*): Dr. P. Chalmers Mitchell.—Some Miocene Cirripedes of the Genera Hexelasma and Scalpellum from New Zealand: T. H. Withers.—The Classification and Phylogeny of the Calcareous Sponges, with a Reference List of all the Described Species, systematically arranged: Prof. A. Dendy and R. W. H. Row.—Contributions to the Anatomy of the Ophidia: Surg. J. C. Thompson.—Observations on Osteomalacia in the Zoological Collections of Manchester and Cleveland: Prof. T. Wingate Todd.

RÖNTGEN SOCIETY, at 8.15.—Reflection of X-rays: Prof. C. G. Barkla.—Experiments on the Reflection of X-rays: Dr. R. W. A. Salmond.

WEDNESDAY, JUNE 4.

SOCIETY OF PUBLIC ANALYSTS, at 8.—An Electrochemical Indicator for Oxidisers: E. K. Rideal and U. R. Evans.—The Estimation of Tannin in Tea: H. L. Smith.—The Detection and Estimation of Nickel by means of *a*-Benzildioxime: F. W. Atack.—The Analysis of Various East Indian Tanned Hides: M. C. Lamb.—Note on the Sterilisation of Rag Flock Samples: L. Reed.—A General Method for the Detection of Caramel: P. F. Thompson.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems. II.: Prof. W. Bateson.

THURSDAY, JUNE 5.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Origin of Mammals: Dr R. Broom.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. III. The Structure of Crystals: Prof. W. J. Pope.

FRIDAY, JUNE 6.

ROYAL INSTITUTION, at 9.—Reflection and Refraction of Light as Concealing and Revealing Factors in Sub-aquatic Life: F. Ward.

SATURDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—Radio-activity. III. The Radio-active State of the Earth and Atmosphere: Prof. E. Rutherford. (The Tyndall Lectures.)

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